POPULAR SCIENCE MONTHLY

DEC. 1947
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Diving Balloon
p. 82

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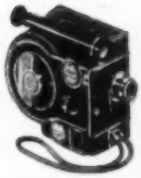

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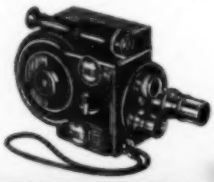

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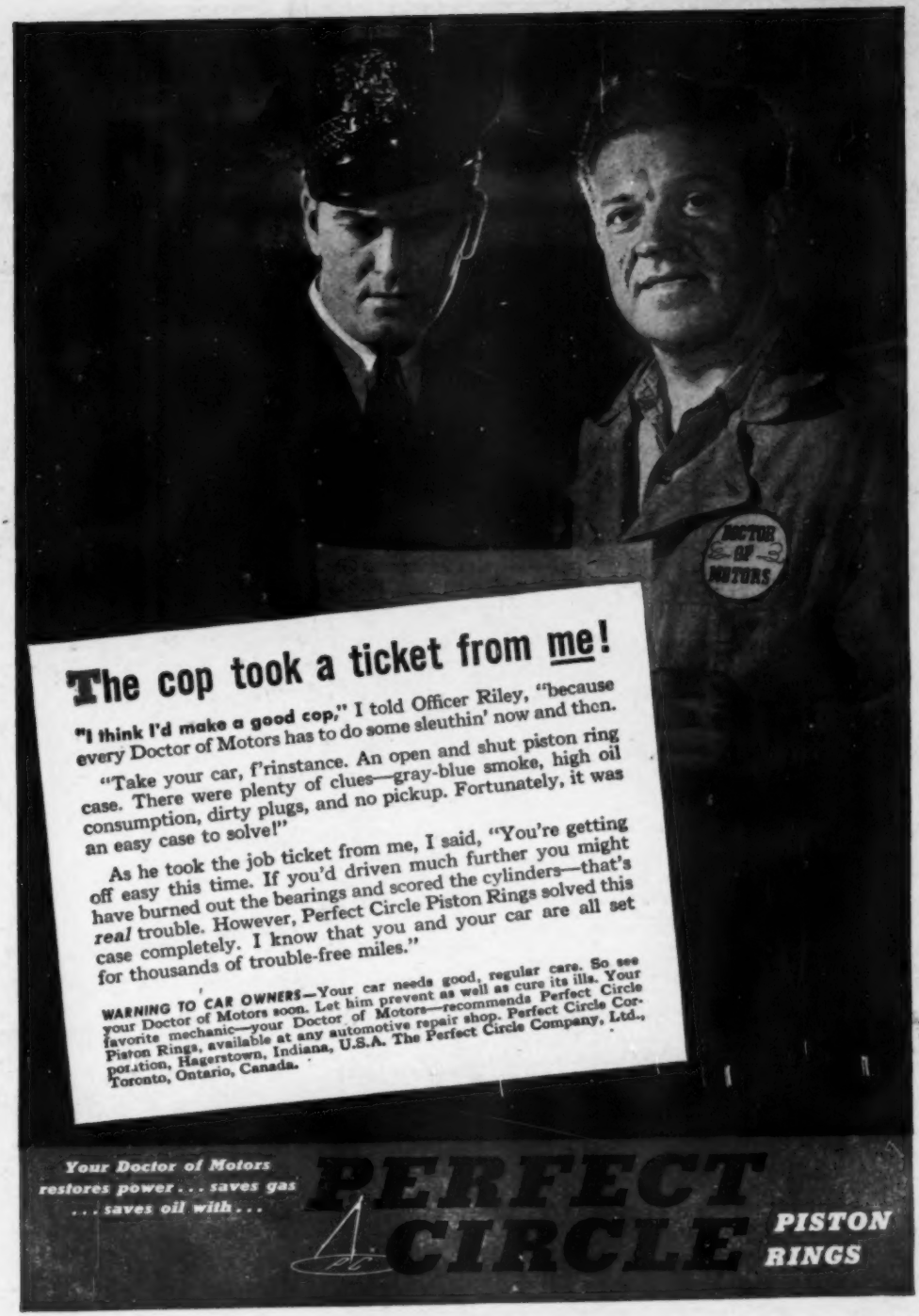
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POPULAR SCIENCE

MECHANICS AND HANDICRAFT REG. U. S. PAT. OFF. *Monthly*

VOL. 151 : NO. 6

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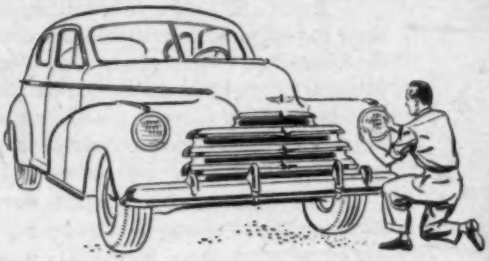

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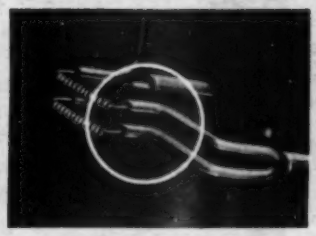

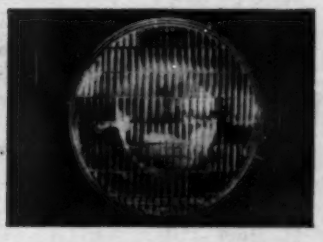

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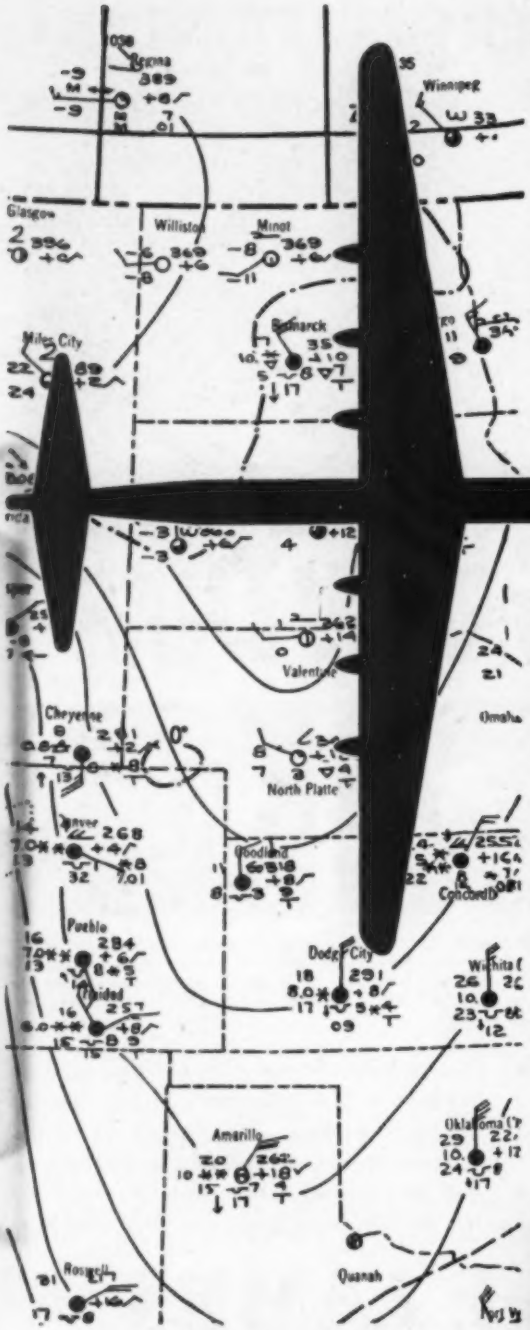

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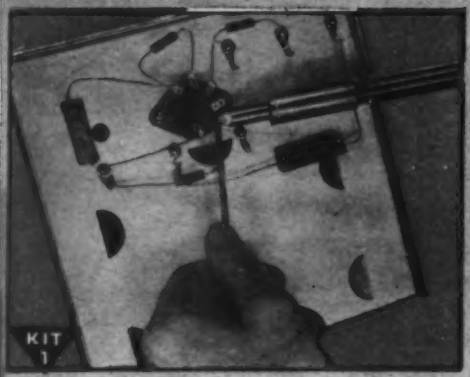

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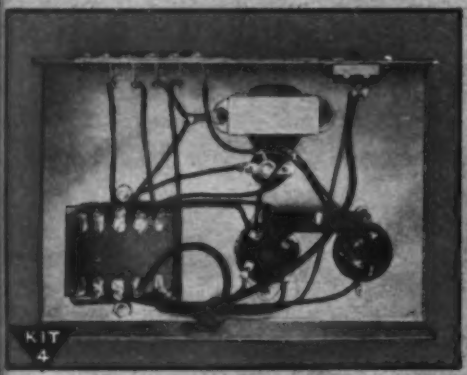

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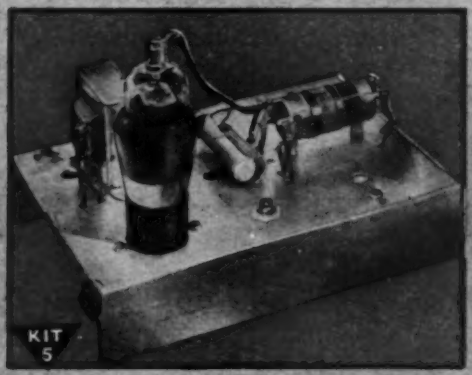

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Scribe J. J. X.
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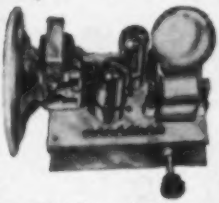

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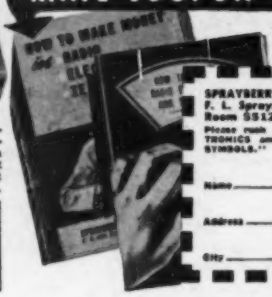

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A patent gives the inventor the exclusive right to prevent others from making, using, or selling the invention claimed in the patent for a period of seventeen years.

The Patent Laws were enacted for the benefit of the inventor to give him protection for the features of his invention which are patentable. These features must be properly and concisely set forth and claimed in a formal application for patent, in order to comply with the requirements of the U. S. Patent Office. For that reason, the Patent Office advises the inventor, unless he is familiar with such matters, to engage a competent registered patent attorney or agent to represent him. We maintain a staff of registered patent attorneys ready to serve you in the handling of your patent matters.

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LETTERS

More than One Way

Sir:

In your excellent article, "Taming the Turbojets," (Oct., p. 82) you state that air is bled from the compressor, routed around the engine, and burned in the tailpipe.

As I understand it, the bled air is not routed around the engine, but is ducted beneath the burners and splashed against the turbine disk face to cool it. . . .

JOHN M. GASKA

Amsterdam, N. Y.

Both Mr. Gaska and PSM are right. The different systems are just two of a number of variations in gas-turbine design that at some time or another have been tried.

Praise from a Neighbor

Sir:

May I take the opportunity to congratulate Mr. Stevenson on his fine article on motorcycles in the August issue (p. 138).

I am contemplating a tour around the world on a motorcycle next year, and the Jawa motorcycle attracted my attention as being the ideal bike for such a trip because of its simplicity and the low upkeep characteristic of two-cycle engines. . . .

GORDON LING

Belleville, Ontario

Seeing Isn't Believing

Sir:

There are no windshield posts on the station wagon described on page 154 of the September issue. . . . The roof is entirely self-supporting. . . .

PAUL STANLEY
Queensway Motors

Queensway, London

Call them what you will, the side edges of the windshield frame still look like narrow posts, supporting or otherwise.

INVENTORS

Patent Laws Encourage The Development Of Inventions

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Send me further particulars as to patent protection and procedure and "Invention Record" form at once. I understand that this request does not obligate me.

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THE GOOD THINGS OF LIFE

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It's a perfectly natural human desire to want more money, a better job, prestige and all the other good things of life. Who gets them? Look about you. Success you will see, comes to the man who is trained for his job.

A new world of opportunity is today beckoning to ambitious men. One of the most important and exciting fields is **INDUSTRIAL ELECTRONICS.** It is attracting experienced electrical men as well as younger fellows seeking a way to bigger earnings and a more secure future.

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Industrial Electronics is not Radio. It has nothing to do with radio transmitters and receivers. It is totally new application of electric power, applied to modern production by means of the magic of the vacuum tube. Everywhere industrial electronic devices are replacing the old-time electrical controls, and processes. Industrial Electronics is Modern Industrial Electricity.

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GET READY NOW!

Now is the time to get into Industrial Electronics, while the field is in its infancy . . . and while it is rapidly developing a need for thousands of trained experts. Tomorrow's leaders are training today.

And here is a School equipped in every way to train you for Industrial Electronics work—one of the largest and most completely equipped, and one of the few of its kind in America—a School that already has trained thousands of men for industrial opportunities.

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Learn Industrial Electronics—now, while the time is ripe. You don't need any advanced schooling or previous experience. If you are at all mechanically inclined and have gone to high school for at least one year or have an equivalent education, we can teach you Industrial Electronics.

You can take most of your training at home, in your spare time—or you can come to Chicago and take your entire training in our completely equipped shops and laboratories. Either way you quickly acquire the fine points, practical skill, and broad, technical "know how" that makes the expert Industrial Electronics Technician.

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ARE YOU A VETERAN?.....

Pellets Get a Pelting

Sir:

Pictured at the top of page 102 ("Rain of Seeds Brings Desert Back to Life," PSM, Sept. '46) is some love grass planted in 1945. As 1946 is the only year mentioned for the airplane seeding, I assume the grass in the picture was planted by a conventional method. Am I right?

It's several years since I have experienced a good hailstorm, but my recollection is that the stones mostly bounce when they hit the ground. . . . I can believe that the pellets might embed themselves in mud, but can they actually puncture the desert pavement?

And finally, I wonder how the cost of this project is justified on almost worthless land. . . . If this is for the benefit of the Indians, perhaps there would be less uncertainty and more economy in distributing the taxpayers' dollars directly over the reservation. . . .

D. JOHNSTON

Oak, Neb.

To answer Mr. Johnston's questions, PSM called upon Clifton Abbott, from whom it procured the original story. Here is Mr. Abbott's reply:

Sir:

As *Popular Science Monthly* said, the grass shown was a "test plot" and was not the result of pellet planting. . . . Test plots are relatively small, never more than a few square feet. They are hand-sown. . . .

The purpose of the pellet material is twofold: to give the seeds sufficient weight to drop directly to the earth without scattering, and to surround them with earth, fertilizer, insecticide and rodenticide so that 99 percent germination will be assured. . . .

Since this eliminates the necessity of burying the seeds, the use of "penetration" is probably an unhappy word choice.

As for the land's worthlessness, it is poor only because it does not grow enough grass to support livestock. In the winter, Army planes have had to drop taxpayers' money over Indian reservations in the form of food and blankets to lessen cold and hunger. Had the land been capable of supporting sheep and cattle, this expense would not have been necessary. . . .

In past years billions of dollars have been spent on dams in Arizona and the South-

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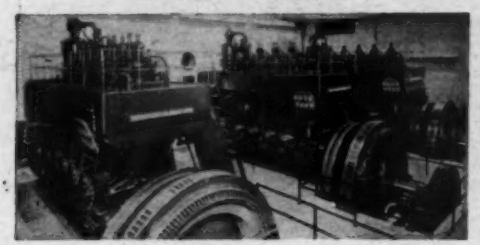

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west. They are rapidly filling with silt from eroded land. The annual cost of dredging them is many times greater than would be that of reseeding the entire United States by the air-planting method. . . .

CLIFTON ABBOTT

Tucson, Ariz.

Better Late than Never

Sir:

. . . I was a little startled when I read in a recent issue (PSM, June '47, p. 180) of a knock-down boat . . . . As long as I can remember—and I am now 28—these knock-down boats have been in common use here in Germany, especially in the region of the Alps . . . .

The craft can be packed so neatly that you can store it in any car or trailer or carry it on your back, bicycle or on the train. It was used on several expeditions in South America, Africa and the Arctic regions . . . .

When I went through some very old magazines of the years 1930 and 1931, I found several pictures and ads of this sport, which I am enclosing as proof . . . .

OSKAR SCHWARZ

Stuttgart, Germany

German versions of the folding boat have indeed been in use for many years, as Mr. Schwarz states. One of them is shown in action, circa 1931. The ubiquitous American automobile, however, has made it possible to transport full-sized boats, and the folding variety has remained more of a novelty in this country.

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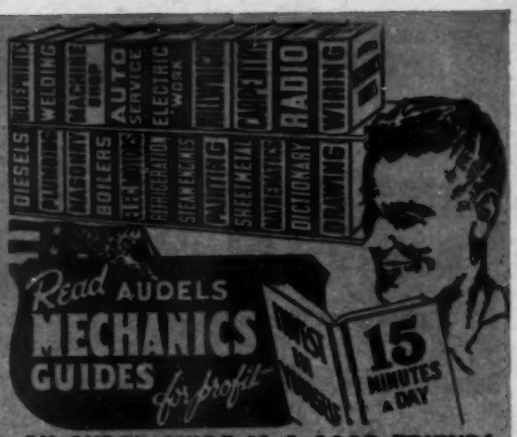

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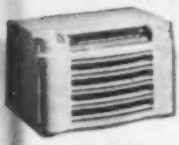

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It Isn't That Easy

Sir:

In reading through your September issue, we found the following figures on page 149: "The 85,000 taximeters in the United States last year ticked off more than $2,000,000,000." According to our slide rules, this makes about $23,500 for each taximeter.

If these figures are correct, we should quit school and go buy a couple of cabs. . . .

E. Louis Linky, Jr.
M. B. Roughton

Washington, D. C.

While correctly determined, the figures were based on what has since proved to have been an abnormally prosperous year and are therefore not typical. Actually, the average annual take is closer to $1,000,000,000. Now divide this roughly in half again for your drivers' share. Then there are such items as gas, oil, maintenance, repairs, and insurance. Still want to quit school?

Putting Our Feet In It

Sir:

On Page 250 of the September issue, it is stated that a 370,000-pound milling machine is resting on a 300-cubic-foot concrete foundation. Now me, I am right in the middle of Missouri, b'gosh, and just have to be shown. Can you show me?

J. T. Glas

Tacoma, Wash.

'Fraid not. The figure should have been 300 cubic yards, not feet. GM gave it in feet, however, and PSM passed it along.

Oops, Wrong Pole

Sir:

If a bar magnet is held against a needle, it will magnetize it, and the needle can then be used to pick up a second needle. But if the first needle is touched by the opposite end of the magnet, it will drop the second needle. Why?

(no signature)

Port Clinton, O.

When the first needle is touched with the bar magnet, its polarity will be reversed. During the brief transition period, the needle will be demagnetized, and thus the second needle will drop.

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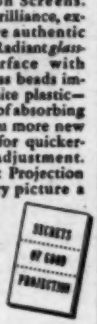

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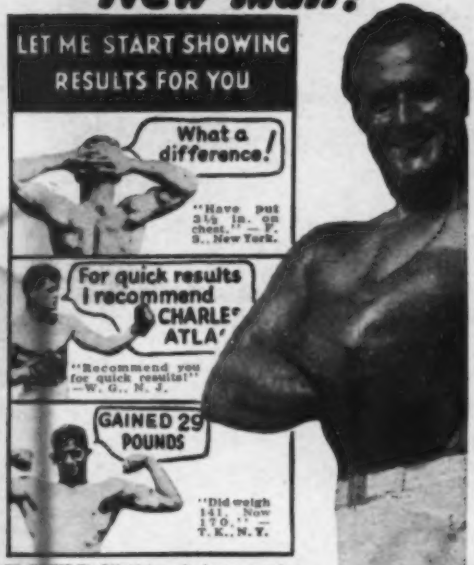

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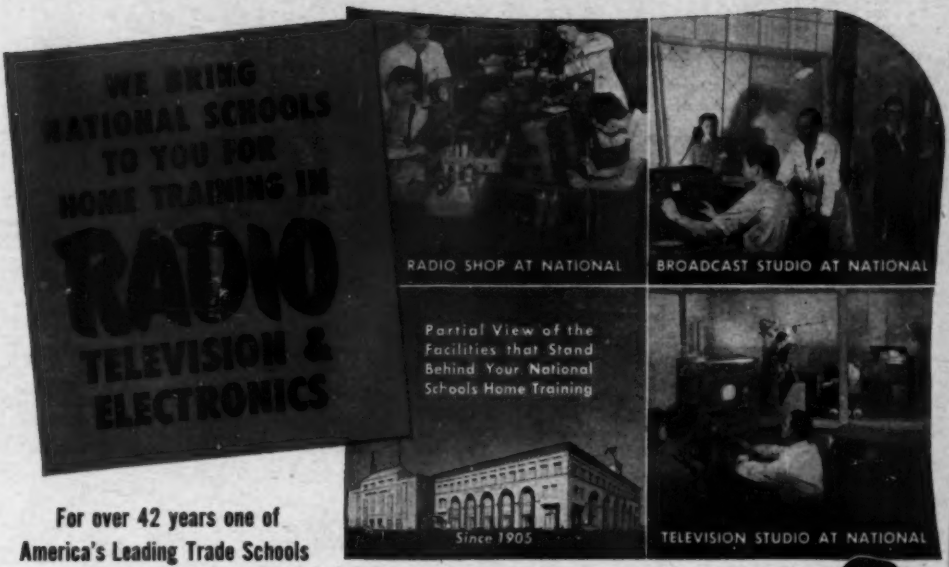

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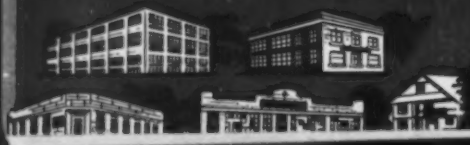

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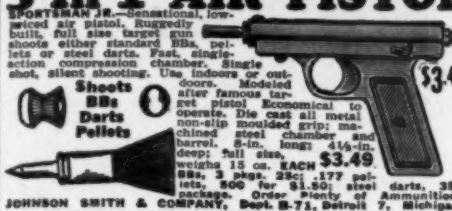

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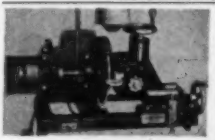

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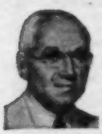

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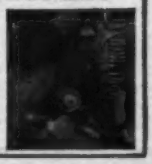

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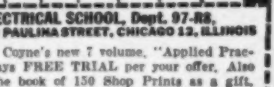

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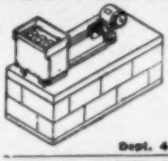

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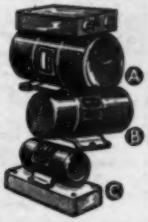

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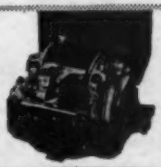

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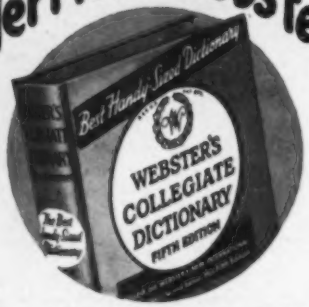

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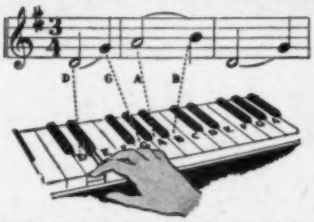

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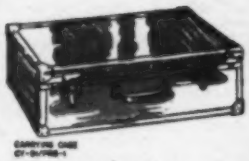

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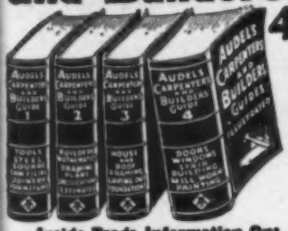

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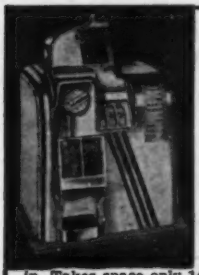

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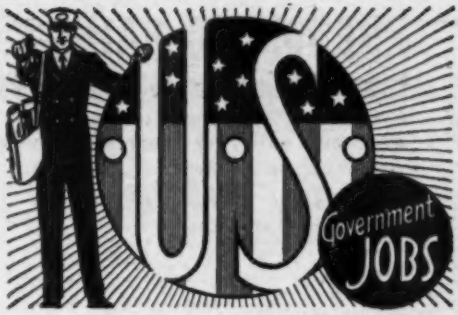

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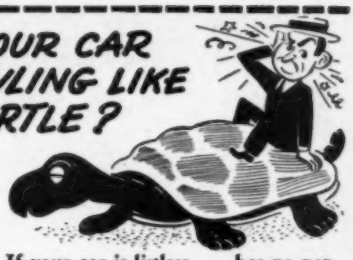

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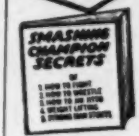

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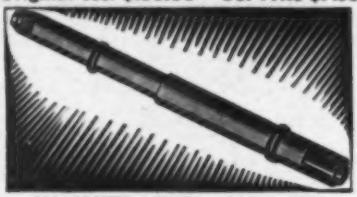

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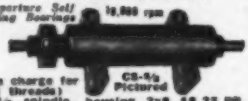

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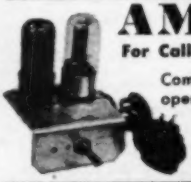

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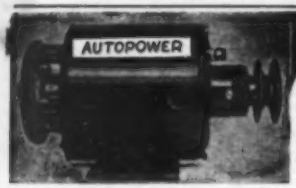

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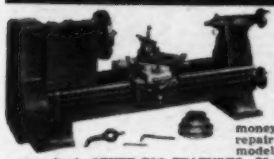

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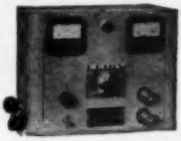

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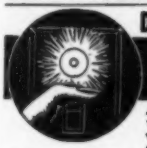

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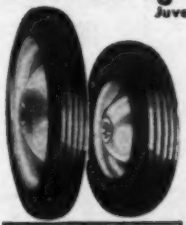

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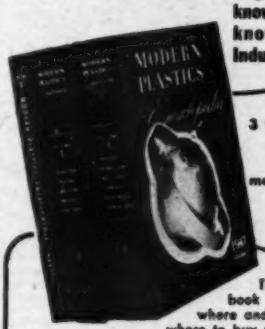

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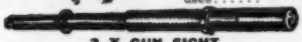

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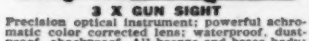

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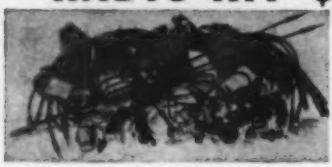

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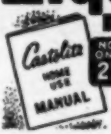

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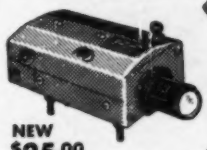

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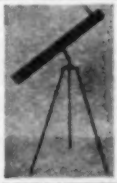

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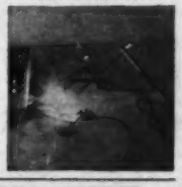

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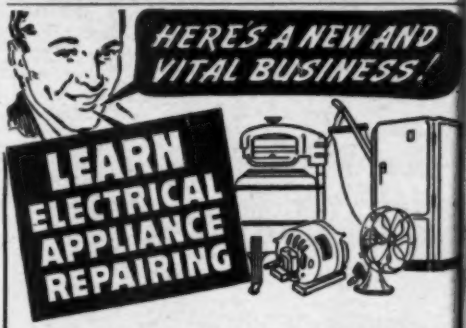

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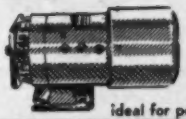

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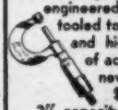

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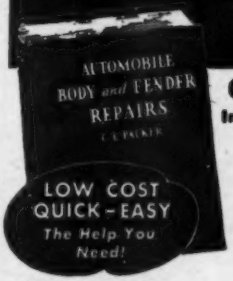

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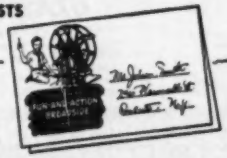

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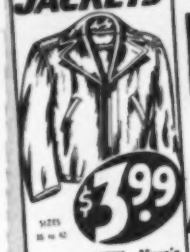

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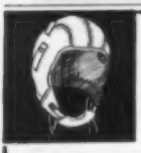

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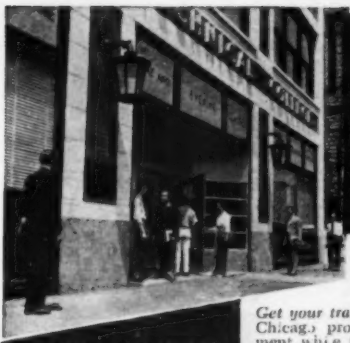

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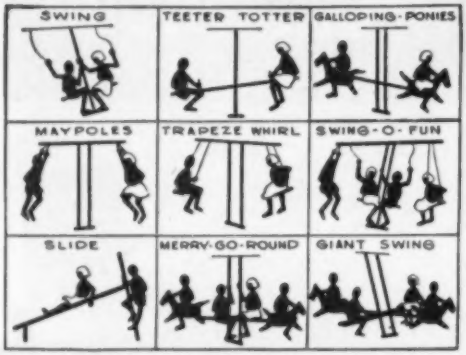

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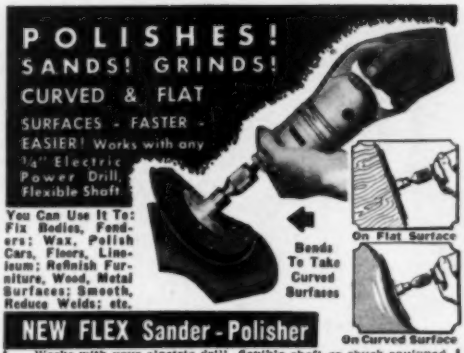

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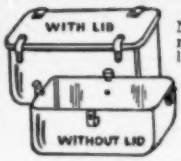

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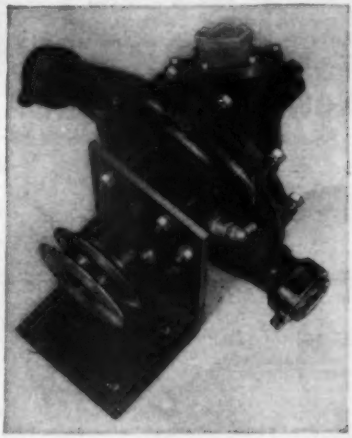

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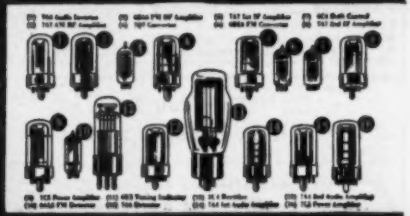

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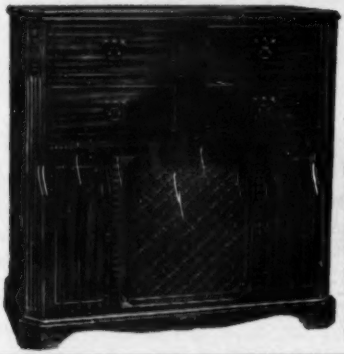

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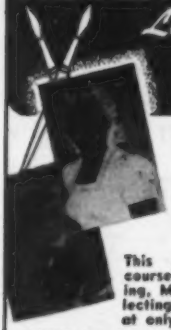

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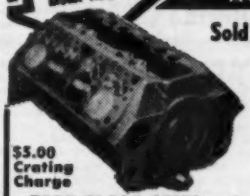

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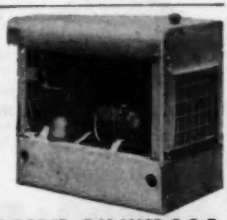

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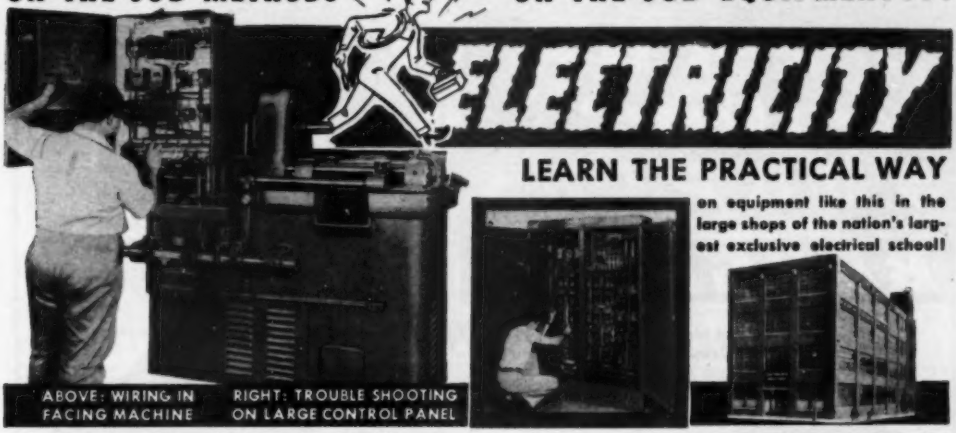

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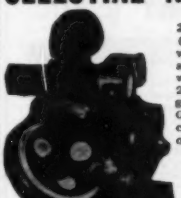

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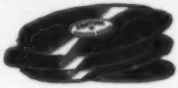

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MAKE Rubber stamps, plaster novelties, metallize baby shoes, silver mirrors. Catalogue of "20 Ideas" free. Universal, Box 1098-B, Peoria, Ill.

NATURAL Rubber Latex. Extra Thick. Sample Jar 25c. Literature Free. W. Wooley, 111-B Donald, Peoria, Ill.

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76 JEWELRY

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86 MISCELLANEOUS

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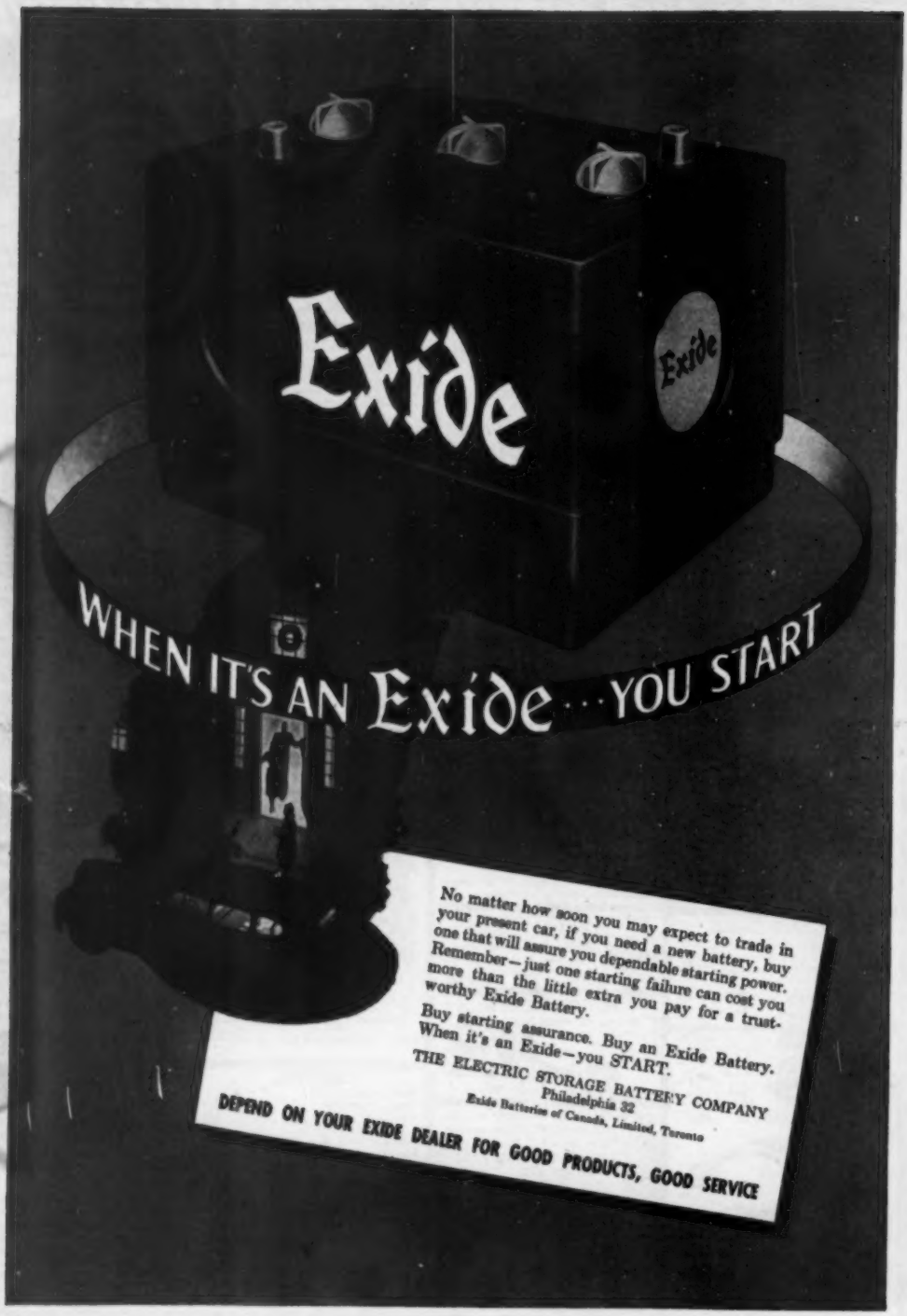
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SOME people, I notice, are afraid of the word "science." They seem to think it's too hard to understand; or it reminds them of the schooling they didn't like or didn't have.

This is as silly as not using a knife and fork because you don't know metallurgy. It's shut-eyed thinking because we live in the very midst of science. Every time you pick up a tool, you hold science in your hand.

Take the ordinary, open-end wrench pictured above. Used one many a time, haven't you? Probably the very first time you pulled down on a tough nut you found that the further out you hooked your hand, the less beef it took. Maybe you even figured out by trial that doubling the distance halved the effort. But did you have to get down a book and study up on, "lever, principles of," before reaching for the wrench? Certainly not!

There's really no need to fear science, or the mere names and fancy words which package ideas in science. I can assure you there are plenty of scientists who wouldn't understand words many a mechanic uses without thinking. Words like *collet*, or *rabbet*, or *hob*, or *mandrel*.

In fact, you don't even have to understand science to be scientific. The most brilliant scientists work with many things they don't understand, especially in the almost unknown new world inside the atom. But they are scientific in their ignorance. They stand on what they know to reach for what they don't know.

So don't be afraid to touch the unfamiliar. The best tool in any good workman's kit is a brave mind that can look its own ignorance in the eye. And say, "So what?"

Perry Gilkeson

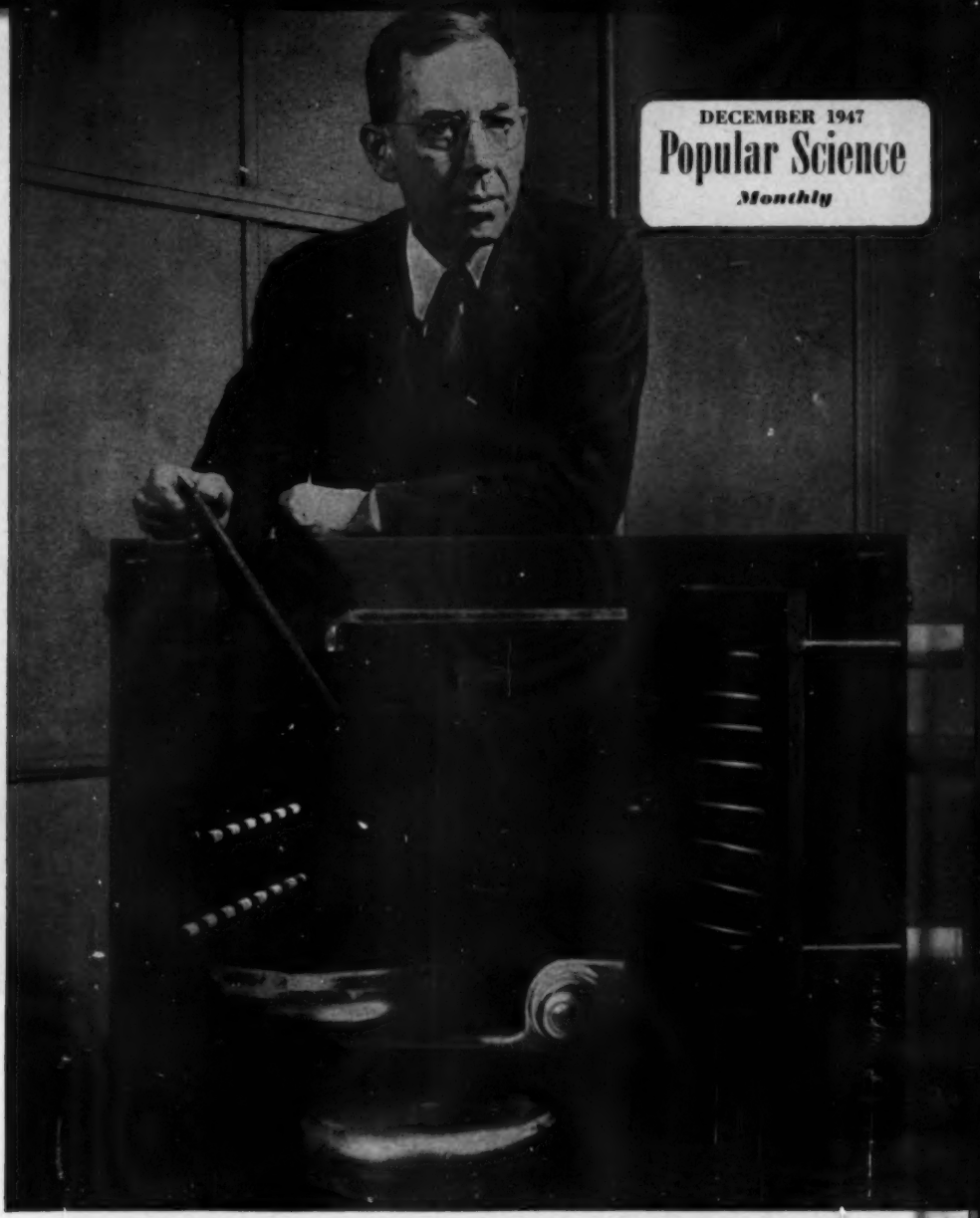
You're sure to please with PRINCE ALBERT SMOKING TOBACCO

Look at this colorful, Christmas-wrapped pound tin of crimp cut Prince Albert Smoking Tobacco. It's all ready to say "Merry Christmas" to Dad, to Brother—to any man who enjoys choice tobacco—in his pipe—or in roll-your-own cigarettes. P. A. is rich tasting, mild, and easy on the tongue. Yes, you're *sure* to please with P. A.!

R. J. Reynolds Tobacco Co., Winston-Salem, N. C.

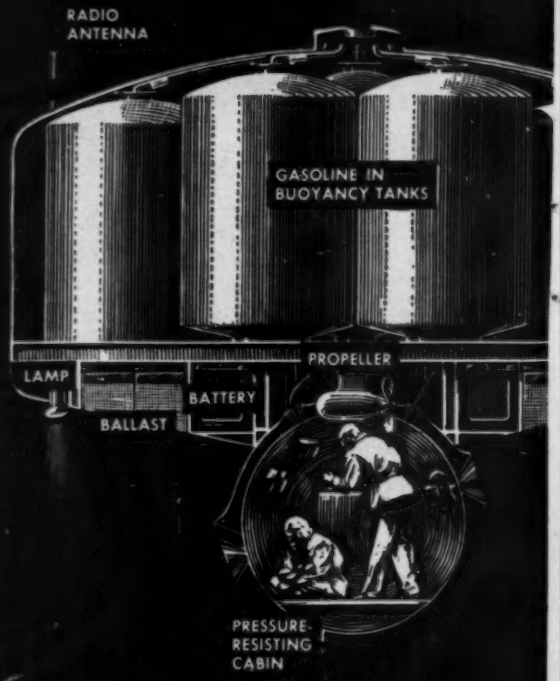
MORE PIPES SMOKE PRINCE ALBERT THAN ANY OTHER TOBACCO

THE NATIONAL JOY SMOKE



Tomorrow's Power Plant?... This model of an atomic power plant is a blueprint of how we may put atomic energy to work. At left is the atomic pile where matter is changed into energy by splitting uranium or other fissionable material. Dr. Kenneth H Kingdon, head of GE's atomic-power laboratory, is holding a rod of the "fuel" material. Striped rods below represent control rods, which act as throttles to regulate chain reaction. Fluid pumped through the pile would carry its heat to the heat exchanger at the right, where water—without being made dangerously radioactive—would be turned to steam, driving turbines and converting atomic heat into mechanical or electrical power.

Piccard's Submarine Balloon



Professor Piccard's self-propelled "ship of the deep," with pressureproof cabin for pilot

A famous explorer of the stratosphere designs a remarkable undersea craft for a journey to ocean depths never before reached by man.

By Charles Wright,
Aneta News Agency Correspondent

BRUSSELS, Belgium—(Special to *Popular Science Monthly*). By applying the lifting principle of a balloon to a diving chamber, Prof. Auguste Piccard, pioneer explorer of the stratosphere, has found a way to descend to greater depths of the ocean than man has ever reached before. He has embodied his idea in a submarine craft of extraordinary design, able to navigate more than two miles beneath the waves. As this is written, he and his Belgian assistant, Prof. Max Cosyns, of Brussels University, are preparing to entrust their lives to the invention in the Gulf of Cuinea, off the Ivory Coast of Africa.

The existing deep-sea record was set in 1934 by Dr. William Beebe, of the New York Zoological Society, off Nonesuch Island, Bermuda. His spherical steel diving chamber, or bathysphere, was lowered to a depth of 3,028 feet by a steel cable.

Professor Piccard's subsea craft, in contrast, will not be suspended from its mother craft. Instead, it will navigate under its own power, driven by two propellers with elec-

and observer, is shown at left attached to "balloon." At right is view of cabin's interior.

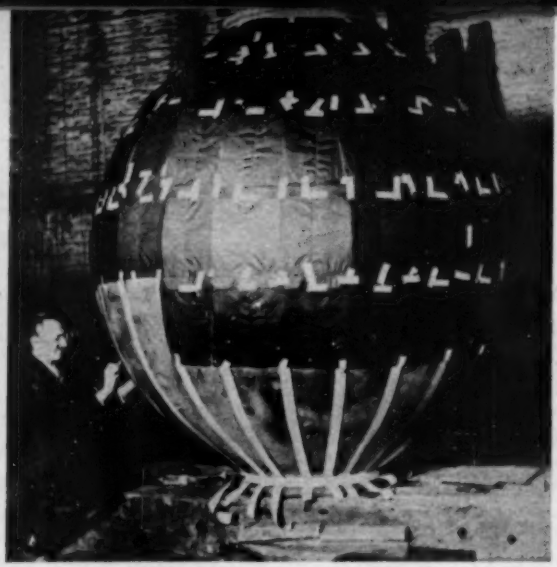
tric motors. The bushy-haired, 63-year-old, Swiss-born professor intends to take it down to a depth of two and a half miles, which is more than four times as far as Dr. Beebe went, to make scientific observations in an unexplored region of eternal night.

Armor Withstands Pressure

Combining the Greek words for depth and ship, Professor Piccard calls his craft a "bathyscaphe," or ship of the deep. Pilot and observer will ride in a hermetically sealed, alloy-steel sphere 6½ feet in outside diameter. Its massive walls, 3½ inches thick, will safely withstand the tremendous pressure of more than 5,700 pounds to the square inch—about a ton for every mile of descent—resulting from the crushing weight of water overhead. Two windows of transparent plastic, measuring 16 inches in outside diameter, four inches in inside diameter, and six inches thick, give the crew a view into the lower depths. At the points where these ports are inserted, the walls of the sphere itself are correspondingly thickened for strength. The greater the water pressure upon the windows, the more tightly they are forced against their conical seats, preventing any leak. Electrical cables enter through smaller cones of plastic, similarly providing a watertight seal.

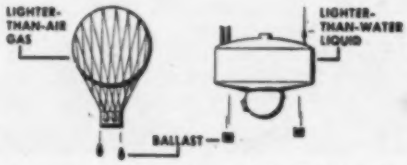
So that the men inside the globe can control its ascent and descent at will, Professor Piccard suspends it from a "balloon"—a

Professor Piccard (holding section from bathyscaphe model) and Dr. Cosyns examine results of test to tell how much pressure the cabin of their undersea craft can safely withstand.



By placing radium within the cabin and attaching photographic films in envelopes to the outside as shown, radiographs were obtained to be sure that the steel contained no flaws.

buoyancy float consisting of seven aluminum cylinders within an encircling shell of thin metal. Just as the gas bag of a balloon contains a gas lighter than air, so these aluminum



PRINCIPLE of balloon is used by bathyscaphe. It valves off fluid lighter than surrounding medium to descend, drops ballast to rise.

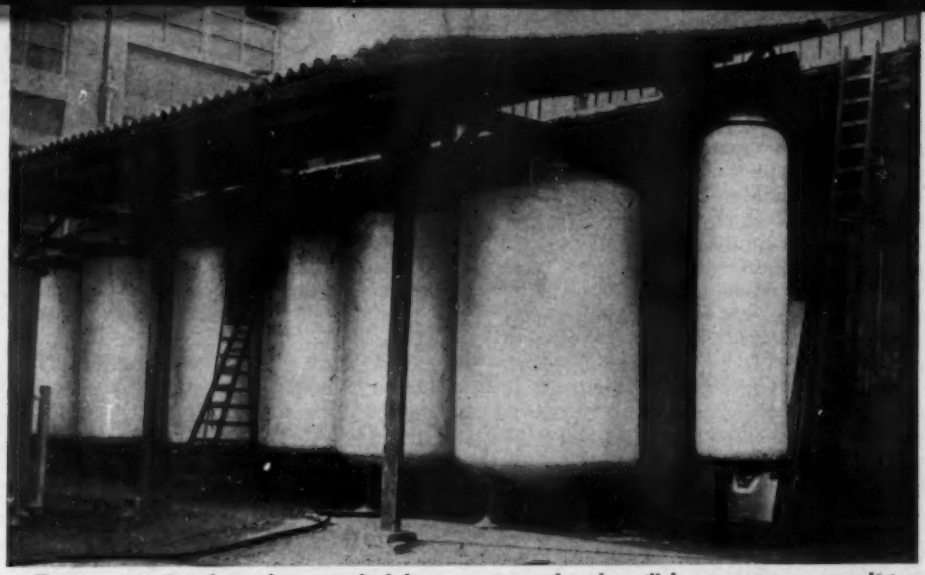
cylinders will hold a fluid lighter than water. For this purpose Professor Piccard has chosen aviation gasoline, which weighs 43¾ pounds to the cubic foot—just 20 pounds less than a cubic foot of sea water. Thus the total capacity of the cylinders, 1,000 cubic feet of gasoline, gives a lifting force of 20,000 pounds, or 10 tons. This will be considerably more than sufficient to counterbalance the weight of the steel sphere—its 10-ton weight out of water becomes 5½ tons when submerged—and its equipment.

The buoyancy tanks are filled with gasoline in preference to air because the extreme pressure to be encountered would compress air beyond all usefulness for displacing water. Even the gasoline, relatively incompressible, will be squeezed to a slightly smaller volume. Hence, openings at the bottoms of the cylinders will admit sea water freely, equalizing pressure inside and out and obviating any need for heavy armored walls such as the cabin requires.

Upside-Down Ballooning

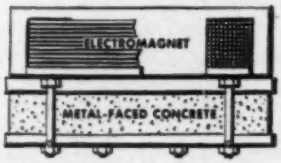
In order to descend, the undersea explorers will "valve off" gasoline, exactly as balloonists descend by valving off gas. To complete its parallel to a balloon in principle, the bathyscaphe will drop ballast in order to rise again. This ballast consists of heavy concrete blocks fitted with iron faces, so that they may be suspended from the float by electromagnets. As long as current flows through these magnets from a 2,600-pound storage battery built into the float, the blocks remain in place. By pressing buttons within the spherical cabin, the occupants may drop any or all of the blocks. For more delicate adjustments of buoyancy, iron shot may be dropped by other electromagnets. A total of 2⅛ tons of ballast may be released and, in an emergency, the storage battery itself may be jettisoned.

Equipment of the submarine gondola will provide every scientific facility for the adventurers' purpose of observing marine life at extreme ocean depths and exploring the



Buoyancy tanks, shown being readied for installation, will hold 1,000 cubic feet of aviation gasoline and give a total lifting force of 10 tons to counterbalance weight of bathyscaphe. Bottoms of tanks will be open to sea, equalizing pressure inside and out. This plan permits them to be made of lightweight aluminum, without need of special armored construction.

bed of the sea. Trained through a window, a motion-picture camera will photograph strange denizens of the deep illuminated by 3,000-candlepower undersea lamps. The films are expected to record a myriad of fish and other creatures new to science, which have eluded nets lowered from the surface in earlier attempts to bring them up for study. Because the explorers will be far too busy to jot down notes on their scientific observations, their rapid-fire comments on what they see will be picked up by the microphone of an automatic voice recorder,



ELECTROMAGNETS enable ballast to be released by remote control from the cabin by pressing buttons cutting current to their coils.

to be played back and transcribed after they return to the surface. By remote control, they will operate equipment on the outside of the bathyscaphe that will trap specimens of deep-sea life, bring up bottlefuls of water, and collect samples of the ocean bed.

A 4,000-ton ocean-going tug, the *Scaldis,* has been fitted out to serve as their floating base of operations. While the bathyscaphe rests on the deck, the two men will squeeze into the cabin through a circular entrance port, containing one of the windows, which will then be sealed into place. A crane will lower the apparatus into the water, the gasoline will be pumped into the buoyancy tanks, and the bathyscaphe will start its plunge.

Color of Sea Changes

Through the observers' portholes, as they descend, the color of the sea will change from bright green to blue-green, darker blue, and then to deepening gray as daylight fades out. As they approach the 2,000-foot level they will enter a wonderland that only the occupants of Beebe's bathysphere have penetrated before—a realm of absolute blackness such as surface dwellers can scarcely imagine, darker than the darkest night and punctuated only by the flashing blue and yellow lights of the weird, luminous creatures that inhabit this nether world. The walls of their steel sphere will become icy cold to their touch. At the depth they will reach, the sea's temperature hovers only a few degrees above the freezing point, summer and winter alike. As pressure gauges show the craft is approaching the sea bed, its distance above bottom will be

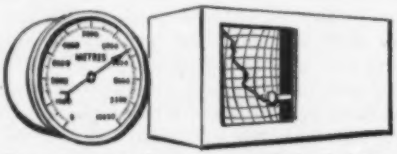
gauged by lowering a weighted cable from a motor-driven drum. By careful control of ballast and buoyancy, Professor Piccard expects to be able to keep the bathyscaphe within a few feet of the ocean floor as it drifts along, or turns on its battery-powered propellers for faster progress. For a better look at objects of interest illuminated by the powerful lamps, varying the relative speed of the propellers will rotate the cabin to face in any direction. Underwater navigation will be aided by a compass mounted on the outside of the cabin, with a connection to an indicator on the inside that will duplicate its reading.

Program for Record Dive

Plans call for an undersea journey lasting from eight to 10 hours, for which oxygen tanks in the cabin provide an ample supply, and an adequate reserve for good measure. Air-conditioning apparatus will keep the air in the sealed cabin purified by means of chemicals, removing exhaled carbon dioxide with soda lime and absorbing excess humidity with silica gel.

Just as a barograph serves to confirm an airplane or balloon altitude record, so a recording water-pressure gauge, whose pen similarly traces a record upon a revolving drum bearing a paper chart, will testify to the greatest depth reached by the bathyscaphe.

As the subsea craft ascends once more and approaches the surface, possibly several miles from its starting point, it will reveal its whereabouts to the surface ship by means of an undersea signaling transmitter loaned



DEPTH gauges for plunge include dial type for pilot, and recording model that will verify level reached if new record is set.

for the purpose by the British Admiralty, a device of a type used during the last war for signaling between submarines with sound waves. Thus the *Scaldis* will be able to reach the bathyscaphe promptly after it surfaces, haul it aboard, and release the men sealed within it. In case of any slip-up, the bathyscaphe is also equipped to signal its surface location by radio and by flares and rockets, and is brightly painted so that, if necessary, search planes should find it easily.

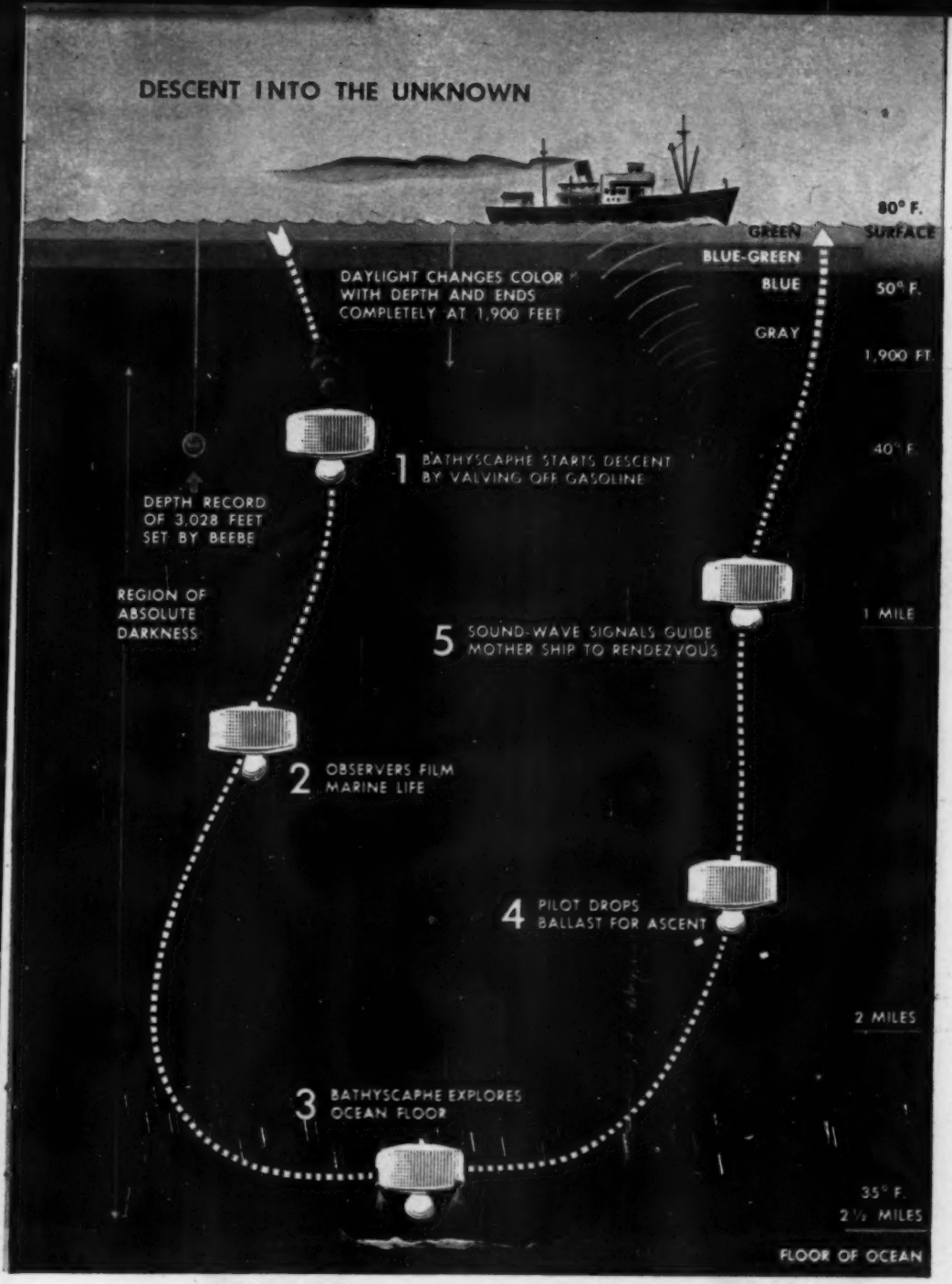
So far as human foresight can provide, every imaginable contingency has been anticipated. Models of the cabin, built to one-tenth scale and tested to destruction in a high-pressure hydraulic chamber, indicate the gondola will withstand two to three times the pressure it will encounter—a generous margin of safety. To insure against defects in its steel shell, a capsule of radium was placed within the ball and its entire

DEEP-SEA exploration by Beebe indicates that Piccard will find a world of darkness inhabited by strange luminous creatures.

exterior was covered with envelopes containing sheets of photographic film. The resulting radiographs revealed the metal to be flawless, save for one inconsequential "bubble" that was drilled out and filled with solid metal, just to be on the safe side. As a final precaution, the first descent with men aboard will be preceded by a full-dress test dive with the craft empty. Sent down to a depth of 3¾ miles, half again as deep as it is intended to carry passengers, it will be preset to release ballast automatically at this level and bob up again. If it survives the titanic crushing force at this depth, a total of more than 72,000 tons upon its spherical shell, it should serve its purpose successfully. Despite every possible precaution, however, the adventurers are well aware that their first descent will be a gamble with death. They are prepared to accept all of the hazards. END

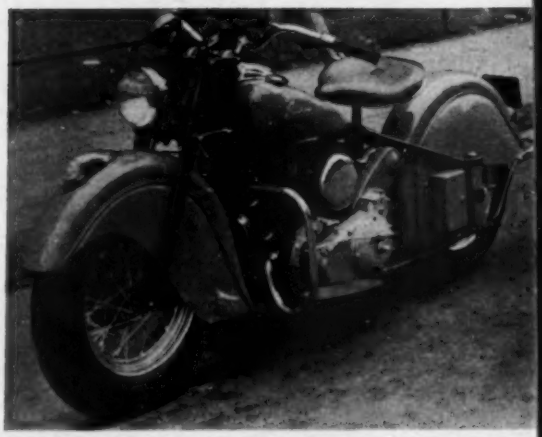
Army Tries an Expendable Spoon

FOR use with combat rations, the Army has developed a plastic spoon that can be thrown away after one meal. Made of polystyrene, it is the Quartermaster Corps' answer to World War II complaints about metal spoons, which were hard to clean, sometimes rusty, and gave away military positions by rattling or reflecting sunlight.



Plans for descent call for a perilous journey of eight to 10 hours to a depth where weight of sea overhead will exert titanic crushing force on the spherical two-man cabin. Drawing shows how explorers will navigate the bathyscaphe and what they will encounter, as revealed by Beebe's pioneer dives in his captive bathysphere and by deep-sea soundings.

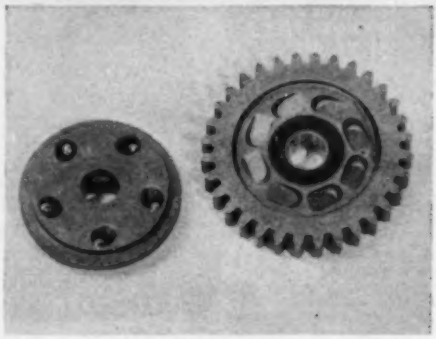
Silent Kick Starts 1948 Motorcycle



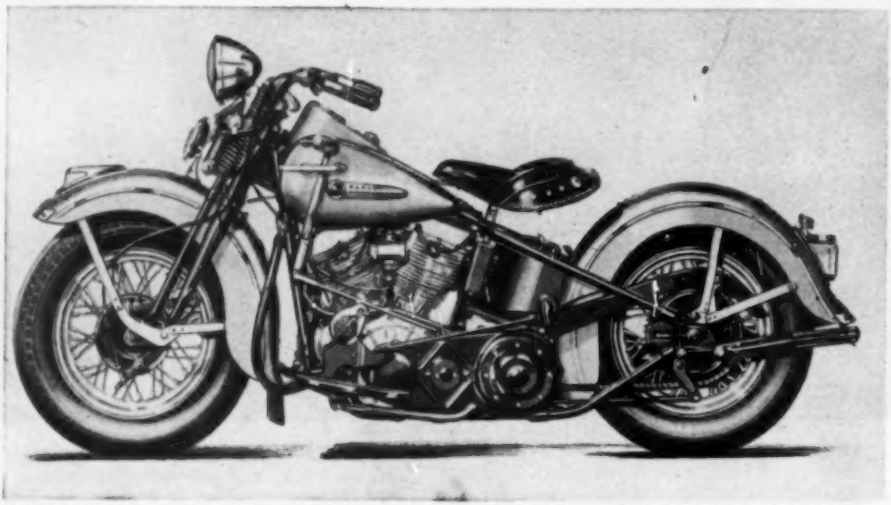
ENGINEERING refinements are featured in the 1948 motorcycles announced by Indian and Harley-Davidson. Starter noise, for instance, has been cut down in the Indian by means of a silent kick starter, in which the usual ratchet is replaced by a free-wheeling ball-lock device. Normally resting in holes in one plate, five metal balls engage in sockets on the gear face when the starter is used. A click—and your motor's running.

The Harley has new tricks, too—aluminum heads, a feature that reduces engine weight eight pounds, and hydraulic valve lifters of the push-rod type for 61-cu.-in. and 74-cu.-in. overhead valve engines. Previously used only in airplanes and high-priced cars, these lifters are self-compensating for expansion, contraction, and wear of the valve train. The rocker arms operate in an oil mist that helps cool the aluminum heads. Top frame members are higher to allow for the rocker covers.

Other new Indian features are a lock to keep the kick-stand leg from folding up if the cycle is pushed, and a five-gear oil pump that replaces the plunger type. The speedometer is operated from the front wheel.



Starters in the 1948 Indians are operated by this two-part ball-lock device. In use, the five metal balls engage in the recesses seen on the gear face. At top is the 1948 Clubman.



Felt-lined covers reduce rocker-arm noise on Harley OHV models. This is the 74 OHV twin.

Flying Wing Weds Jets

THE flying wing and the jet engine have been married to produce the mightiest bomber of them all—the Northrop YB-49—shown here taking off with a roar of smoke on its first test flight.

Its eight, giant J-35 turbojets develop 32,000 hp., almost three times the power of its propeller-driven counterpart, the B-35 Flying Wing. Bomb bays, cargo space, crew quarters for 13 men—including bunks for six off-duty members—are all in the seven-foot-thick wings. Designed for the Air Force as a very heavy bomber, the tailless plane can be adapted to cargo or transport use.

This Road Talks Back

IF YOU cut over that sacred white line on a New Jersey highway, don't be surprised if the road tells you off. The "voice" is a corrugated strip of white cement, 24 inches wide, that hums loudly when tires roll over its hills and valleys (at left, above). Two of these strips, placed on either side of the center lane in a three-lane highway (at right), warn the motorist that he is entering a danger zone. The device is installed on a section of Route 6 near Paterson, N. J.

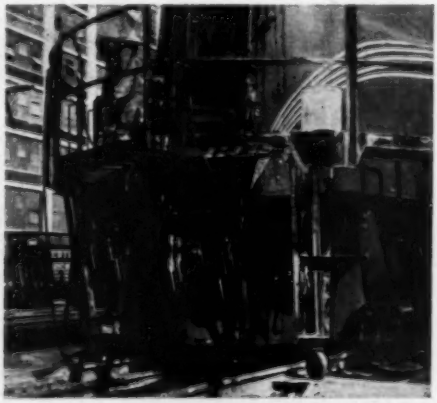
The talking strips not only warn the careless, but are especially helpful at night or in fog when the line is obscured. Designed by Harold W. Giffin, an engineer for the N. J. Highway Commission, the strips originally were planned to reflect headlights. Now engineers are wondering if they can't work out a design so that the road shouts "Get over! GET OVER! GET OVER!"

Locomotive Laundry Scrubs Four an Hour

Getting a shower-plus-scrub at two miles an hour, this dirty engine will soon be shining.

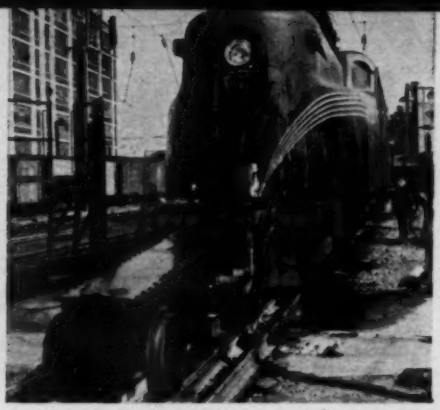
SCRUBBING the grime of travel off a giant electric locomotive by hand takes three hours. But a monster mechanical washing machine in the Pennsylvania Railroad's yards at Long Island City, N. Y., now gives engines a top-to-toe bath and puts them back on the road in 15 minutes. Three hundred feet long, the laundry is semiautomatic, needs a crew of only four men. Here, in pictures, is how it works.

1. The "pig," a winch-drawn pusher, hides under tracks until engine passes, then emerges behind it to shove it through laundry. Engine's 11,000-volt power has to be cut off during bath.



2. Curved platforms swing across track behind and ahead of engine so that two men can climb up to scrub its ends—the only manual part of the process. Here rear end is being groomed.

3. Front end gets the same treatment while the first set of rotary brushes, three on a side, wait in foreground to begin the real scrubbing. Engine reaches this point under its own power.

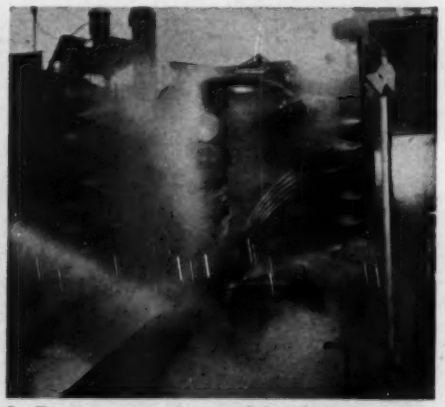


4. After end platforms are swung clear, the pig starts pushing along its narrow-gauge tracks between the rails. As locomotive reaches brushes it is showered with oxalic-acid solution.

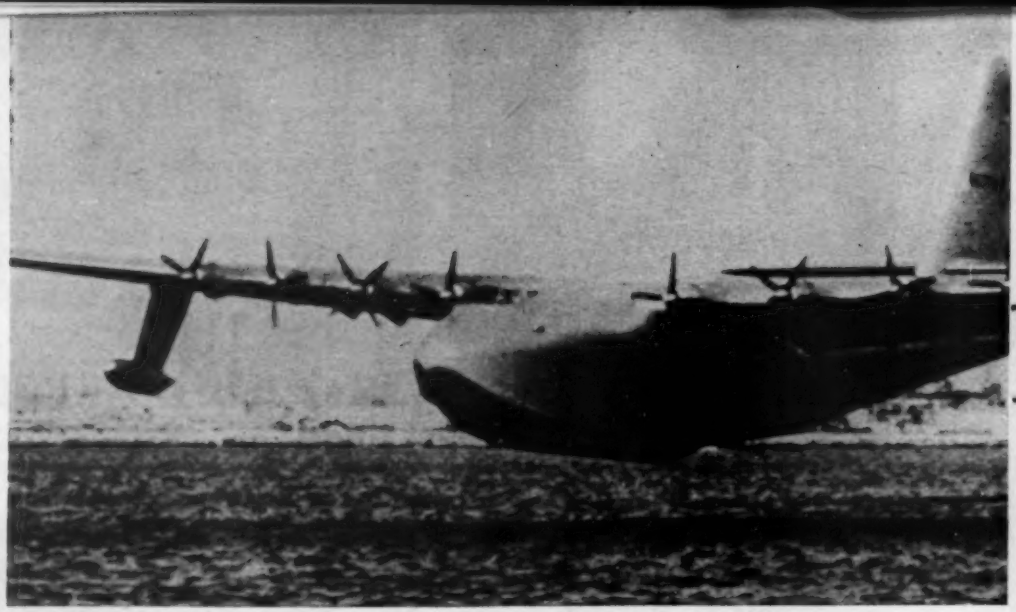
5. Whirling brushes, pneumatically controlled, snuggle their long straw bristles against the engine to follow its contours. Here engine's door moves past a tall side brush.

6. On top, two brushes to a side share vertical and horizontal surfaces. There are two complete brush installations; first set cleans, second set polishes while engine is rinsed.

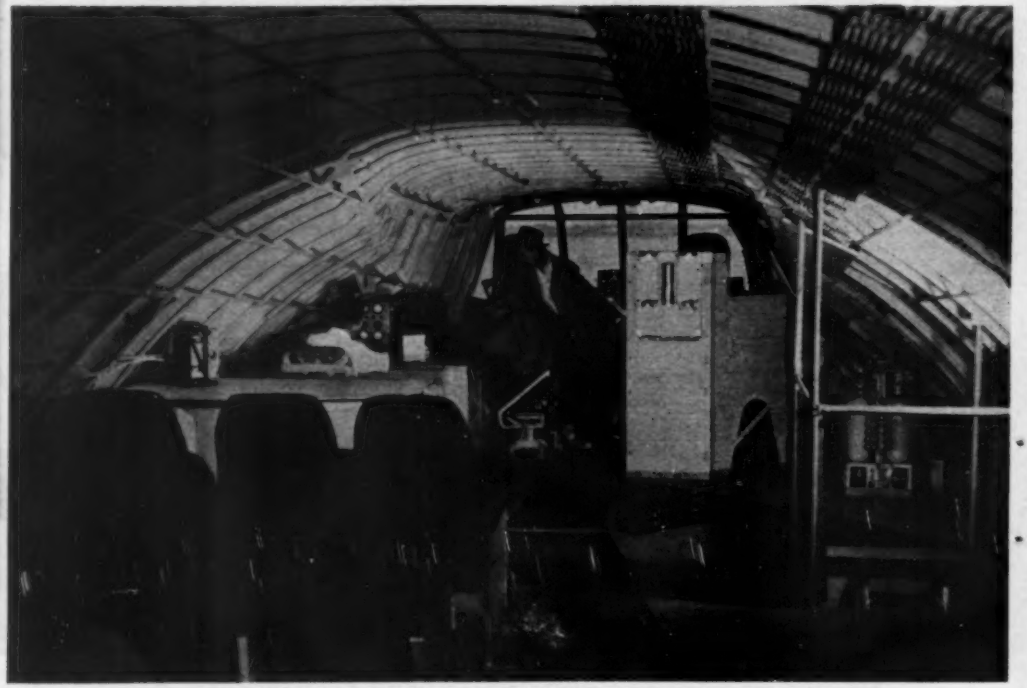
7. Rotary washers spin like pinwheels to blast steam and hot water against running gear as engine passes laundry's midpoint. Treadle on track turns washers and showers off and on.



8. Passing second set of brushes, engine is rinsed, then coasts away to pick up power line. The pig—"cleanest pig in the world," its operators say—goes back for another engine.



World's Biggest Plane Makes



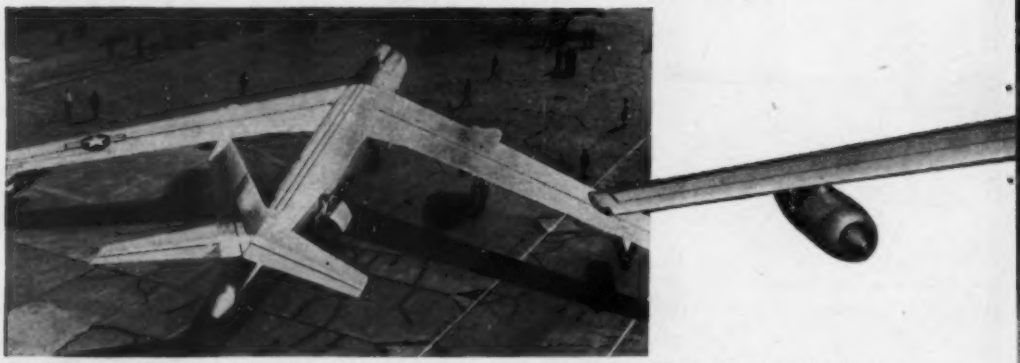
View forward on flight deck of 400,000-lb. flying boat shows upper level of nose. In background Hughes discusses plans for taxi test with flight engineer and radio operator.

First Flight

The biggest airplane in the world, Howard Hughes' huge flying boat, has taken to the air at last. Hughes himself, shown above at the controls, unexpectedly lifted the big ship between 70 and 80 feet in the air during a taxi test in Los Angeles harbor.

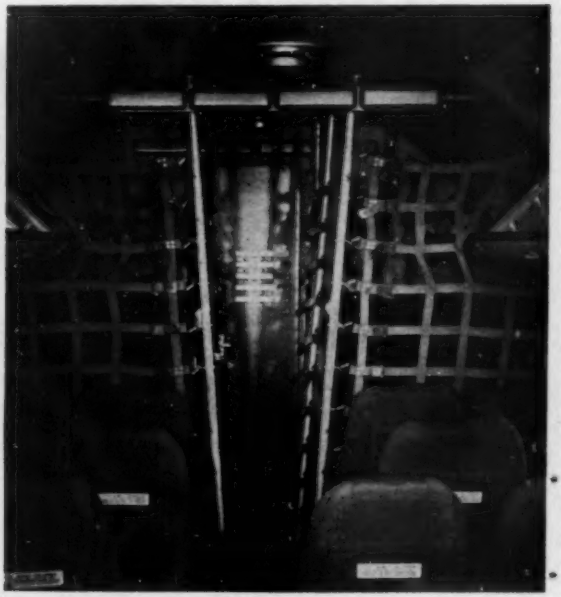
Workmen dwarfed by huge center section of $25,000,000 plane give idea of vast size. Its wing span is 320 feet; length, 219 feet. Plane hit 100 m.p.h. during first test.

What's New in Aviation



Built for Speed. Sharply swept-back wings and tail surfaces make Boeing's six-jet XB-47 really look like a postwar bomber. Double nacelles inboard and single ones near the wing tips provide a novel underslung mounting for the General Electric jet engines, keeping the leading edge of the wings virtually unbroken. Like the Martin XB-48,

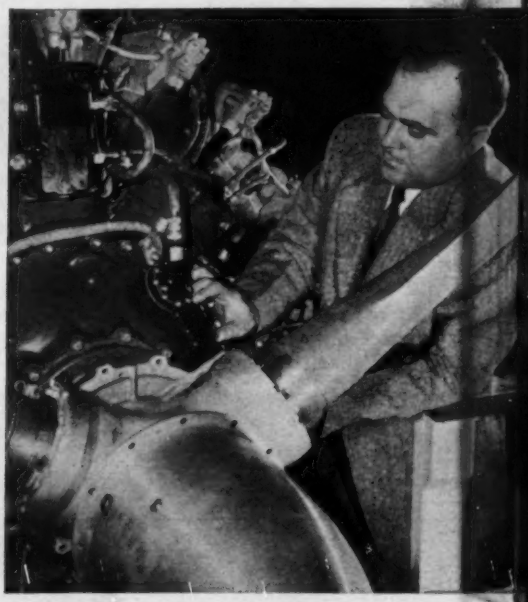
That's No Jet. They may look like exhaust trails, but the twin streams flowing from the wings of this Schweizer all-metal glider are only water Carried in wing tanks as ballast to increase wing loading and thereby boost cruising speed, the water is jettisoned through dump valves whenever flight conditions require maximum lift.



Putting Cargo in the Cabin. To utilize available cabin space, Pan American devised this removable cargo compartment for its Latin American Clippers. Two forward rows of seats are taken out to make room for the stanchions and webbing, which are concealed from the passengers by a curtain when cargo is stowed.

another six-jet bomber designed for the Air Force, the XB-47 has tandem landing gear—main wheels that retract into the fuselage and small outrigger wheels that permit a thinner, high-speed wing. About the size of a B-29, the XB-47 is 108 feet long and has a wing span of 116 feet. Besides its six jets, it has 18 built-in Jato units.

Making Astrodomes Safe. This Northrop engineer is assuring safety for navigators "shooting the stars" through the astrodomes of flying-wing bombers. When the surveyor's transit is aligned with a light inside the clear plastic bubble, tiny deflections indicate any imperfections that might give way under pressure.



Automatic Feathering. That little black fitting on the aircraft engine shown above holds the key to a new automatic feathering device developed for Consolidated Vultee. Inside it are a torque meter and pressure switch; 1½ seconds after the engine fails, they close a circuit that twists the blades and stills the propeller.

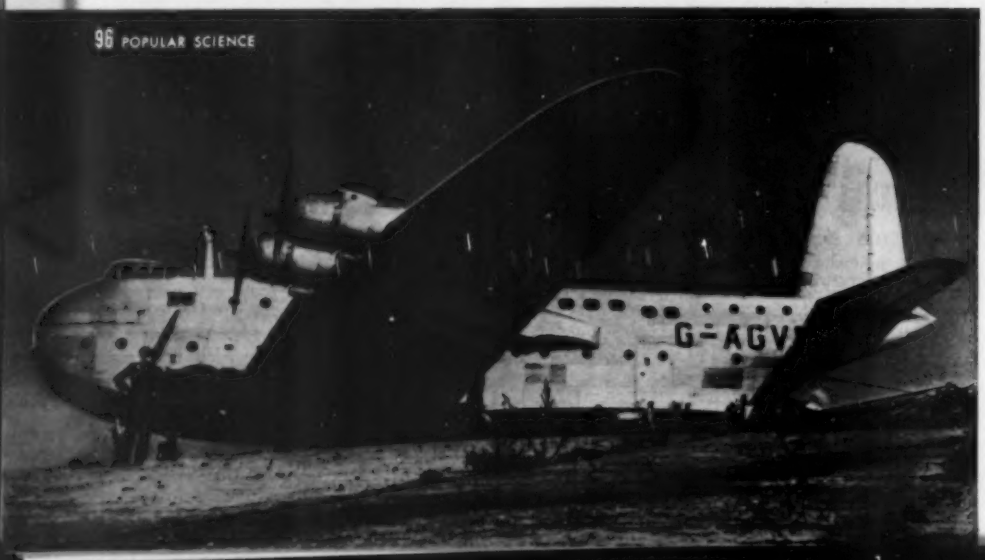
What's New in Aviation

Convertible Freighter. Continuing its versatile line, Britain's Miles Aircraft has turned out the Merchantman, above. Patterned after the earlier Aerovan, the four-engine freighter can be quickly converted into a 20-seat passenger plane.

Wider View for Spotters. The long, two-man greenhouse of Britain's new twin-boom, pusher-type Heston provides an excellent view for artillery observers.

Streak Speeds Up. With a 125-hp. engine, a new version of the Streak 85 is billed as the "fastest personal plane." Cruising speed is given as 192 m.p.h.

Shetland Puts to Sea. New civilian model of one of England's largest flying boats, the Short-Saro Shetland is shown during launching. The big-hulled air liner is 110 feet long, has a wing span of 150 feet, and cruises at 184 miles an hour.



Colonel Gillespie points to push button that started *Robert E. Lee* on automatic flight.

By Col. James M. Gillespie, *Chief, All Weather Flying Division, U. S. Air Force.*

ONE day last September our four-engine transport plane squatted on an airport in the wilderness of Newfoundland. The pilot pushed a button in his cockpit—and then sat back and put his hands in his lap.

The airplane took off by itself. The landing gear retracted itself. The throttles presently crept back to cruising power, though no hand touched them.

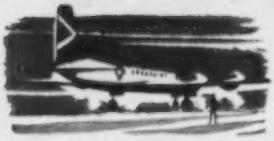
The crew of the plane didn't even know its destination. But the plane knew. It headed east out over the Atlantic as unerringly as a hound on a hot scent.

Hours later, this C-54—named the *Robert E. Lee*—automatically banked and began circling. We were in the vicinity of the airport to which the plane was taking us. Presently we were in a glide, pointed straight for the airport. The downwind end of the runway flashed by. The wheels touched. The throttles cut back to idling speed. Only then did the human pilot, sitting in the cockpit, make a move. With his feet he braked to shorten the landing run. With his hands he kept the plane in the middle of the runway until we rolled to a stop.

We had made the first wholly automatic transatlantic flight in the history of aviation, and I had been lucky enough to be aboard. We had taken off automatically, flown automatically, and landed automatically.

What makes push-button flight possible? What opens and closes the throttles, raises and lowers the landing gear, and points the nose of the plane to its destination? Flight by robot sounds fantastic, even spooky, to the layman.

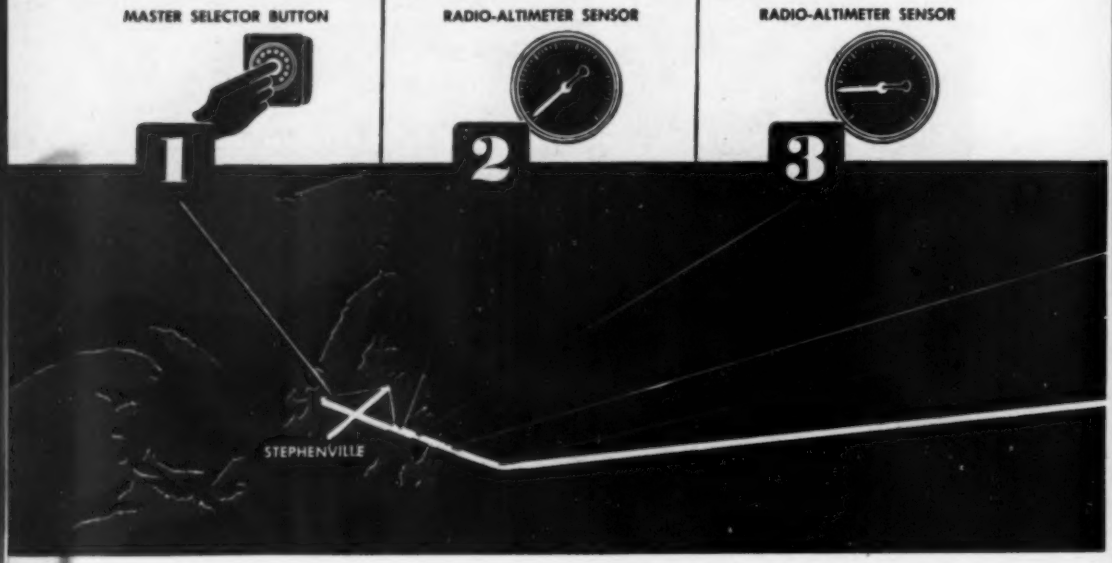
It isn't, at all. What makes our C-54 work



Entry on electronic brain fixed 12 planned sequences for entire flight in advance. In first, idling power is provided for engines. Pilot takes runway heading manually, then presses button advancing Master Sequence Selector to Position 2.

No-hands take-off follows as throttles are advanced automatically to take-off power. Runway heading is maintained as the plane lifts off the field. Fifty feet up, the radio altimeter, the sensor now in charge, advances Selector to Position 3.

Plane keeps climbing straight ahead as take-off power is maintained. Autopilot sets elevators for 1,000-feet-per-minute climb, and landing gear retracts. At 1,000 feet, radio altimeter advances the Sequence Selector to Position 4.



is fundamentally as simple as the thermostat in your living room. The thermostat "senses" that the house is too cool. The furnace is actuated by an electrical command. The same thing happens in the U. S. Air Force's C-54; sensor devices indicate that something is to be done, and an actuating device—an "actuator"—does it.

There was nothing sensational in the way of equipment in the plane. Most of the *elements* of fully automatic flight had been used in aircraft and other vehicles for years. What was new in our plane was that we had taken these elements, put them all together, and added a series of sensing units developed by the personnel of the All Weather Flying Division. It was the *combination*, plus these sensing units built on the chassis of instruments and devices already in use in aircraft, that made automatic flight possible.

When we started our trip to England by way of Stephenville, Newfoundland, our push-button airplane already had proved itself in trial runs here at home. But we knew that flying the Atlantic might be something else again.

There was some tenseness when we neared our first homing radio station in mid-Atlantic. This was a U. S. Coast Guard weather ship on permanent station. About 70 miles from it, according to our air log, we asked the radio operator to hold his key down for 30 minutes so the plane could bird-dog its course.

Would everything work?

It was shortly after midnight, Newfoundland time, as all hands, save for the pilot and copilot who were up in the cockpit, gathered around the master control panel just behind the main cabin bulkhead. Above us the stars were shining. Below us some-

Reaching for the sky, the plane keeps climbing 1,000 feet per minute as flaps are retracted. Compass heading is unchanged. When the predetermined altitude—3,000 to 8,000 feet—is reached, the radio altimeter advances the Selector to Position 5.

The navigator relaxes as throttles close to cruise power and plane takes preselected heading. API (air position indicator) begins counting backward from estimated miles of first leg. At zero, near target, Air Log No. 1 selects Position 6.

Like a homing pigeon, the plane now "homes" on first preselected radio station. Barometric altimeter controls altitude. As plane passes over radio station it is homing on, the radio compass advances the Sequence Selector to Position 7.

RADIO-ALTIMETER SENSOR

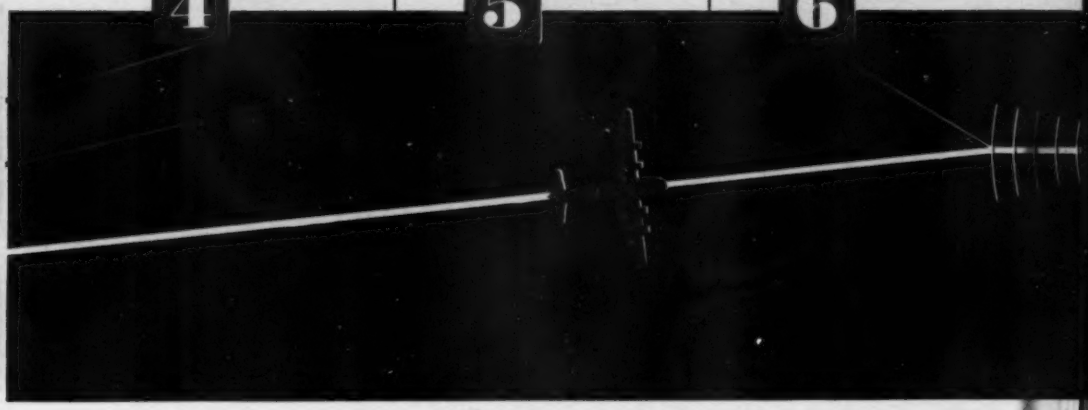
4

API SENSOR

5

RADIO-COMPASS SENSOR

6



where, rolling in the waves, was a tiny vessel. We couldn't see it. We were too high and our plane swam in darkness.

We couldn't even have the satisfaction of a cigarette. Huge cylinders containing supplementary fuel were at our elbows.

On the radio signals from that unseen vessel depended our automatic "fix" in uncharted space. From that point we would proceed to our second air-log sequence. Eyes were trained on a compass needle.

Then everything happened at once. An amber light flashed on the control panel. The sequence was advancing. The compass needle crept around. The plane banked gently, assuming a new course. Nobody said anything. We just exchanged glances. The smile that was passed around contained, perhaps, as much relief as gratification.

But men's faith must be renewed periodically. Again, over the patchwork quilt of fields that was England, we gathered around the master control panel. Our concern was justified. The Royal Air Force had installed the USAF Instrument Low-Approach System (SCS-51) with only cabled instructions. Would there be a hitch?

The airplane crossed the radio station that had led it in. We knew that had happened when the needle of the radio compass—standard equipment in all transports—swung around 180 degrees and pointed backward. It said, "Wait a minute! Your destination is back there!"

The ordinary radio-compass needle is a non-metallic luminous pointer. Ours, however, was made of metal. As it swung, it closed a switch, just as you would switch on an electric light. The compass, of course, was the sensor. Closing the switch put an actuator into operation.

A signal was fed through to the auto-

With uncanny precision, the plane now changes course automatically and takes preselected heading for second leg. Air Log No. 2 starts counting estimated air miles of this leg. When zero is again reached, API advances the Selector to Position 8.

On the last lap, plane homes on the second preselected radio station, located 15 miles from the approach end of the runway at final destination. Radio compass sensor now automatically advances the Sequence Selector to Position 9.

The ghost pilot now reduces plane's power to provide a 500-feet-per-minute descent and craft circles radio station at radius of five miles or less. When 2,000-foot altitude is reached, radio altimeter advances the Sequence Selector to Position 10.

pilot in the cockpit. The autopilot, controlling the ailerons and rudder, put the plane in a gentle bank around the radio station. The signal simultaneously actuated another electric servo system that retarded throttles to the proper setting for a glide.

Some other things were happening. The plane had been kept at a constant altitude through a barometric pressure altitude control of the autopilot—another of the plane's sensory organs. Now, as the throttles came back for the glide, the barometric pressure sensor was switched off. The plane orbitted and started downstairs.

A radio altimeter stepped in as another in the series of sensors. The wheels came down—automatically. The plane's nose picked up the runway localizer of the SCS-51. Then it found the second part of the landing system, the glide path, the invisible highway leading to the runway.

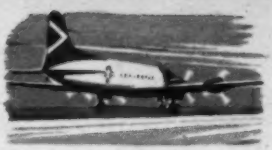
Through the haze we could see that we were landing at the RAF Brize Norton Field. The British had done their work well.

We repeated the experience, giving our plane its head westward back across the Atlantic. Except for three occasions, when proper radio facilities were lacking, the entire round trip was by push button.

While I was the senior officer aboard, the operation of the aircraft was in the hands of seven men headed by red-thatched Capt. Thomas J. Wells, the chief test pilot. He was ably assisted by James L. Anast, chief of the automatic flight branch of the All Weather Flying Division; Captain R. J. Whiting, navigator; T/Sgt. Welker W. McKee, the crew chief; S/Sgt. John C. Nimon, engineer; T/Sgt. Raymond Centolella, radio operator; and George B. Johnson, technician.

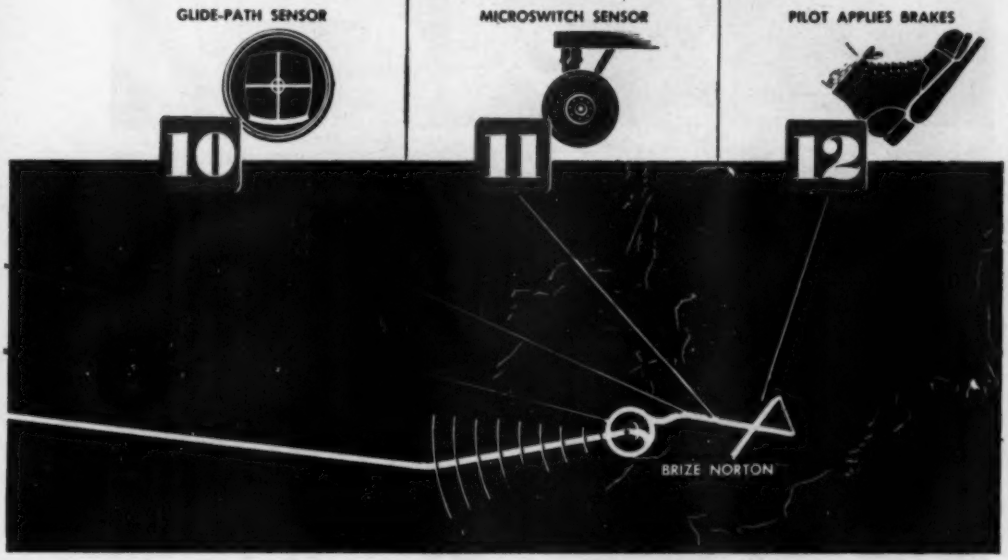
There are only a dozen sequences, or phases, fed into the Automatic Flight Con-

To line up for landing, the plane now seeks the landing system runway localizer and glide path. Landing gear and flaps are extended. Altimeter keeps plane at 2,000 feet until it crosses the glide path sensor. This advances Selector to Position 11.



Coming in, the directional and glide-path course is maintained. Three-point landing attitude is set by pitch-reference signal. Contact with runway operates a microswitch in the right landing gear, advancing the Selector to Position 12.

The ghost cuts the engine to idling speed, as the human pilot applies brakes to shorten landing run, and uses controls to keep plane on the runway. Operation now returns to manual so pilot can taxi plane off runway to parking position.



troller. The system can be modified at will. The fuel-mixture and cowl-flap operations are manual now. Those can be made automatic. Right now the airplane touches down on its two main wheels and its nose wheel. That makes a landing a little rough. It will be simple to add another relay to make the elevator "flare out" the landing at about 50 feet, just as a human pilot does in touching down on the two main wheels first.

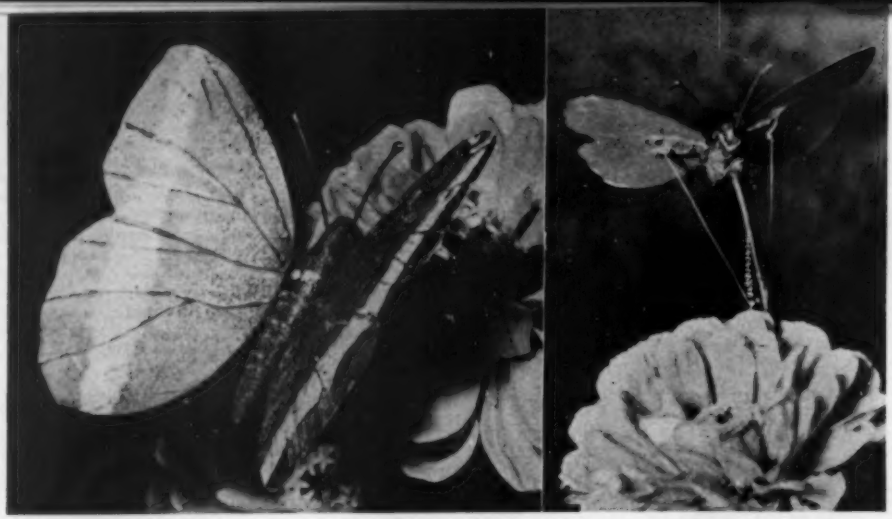
Yet wholly automatic flight does remain experimental. And it is misunderstood by the public. Our C-54 airplane has no relation whatsoever to the guided missile program. The automatic airplane is *not* a guided missile. It is an inhabited plane that has been fixed up for safe, automatic flight. Perfected, it will represent a vast advancement in the art of flying. Today when ceilings and visibility come down, flights are canceled wholesale in the interests of safety. Automatic flight is going to make flying safe, in any weather.

Crewmen on experimental automatic flights are really along for the ride. Of course they have to monitor the equipment and keep notes on performance. When off duty they may play a little gin rummy. George Johnson pocketed 35 cents on the flight from England to Newfoundland.

But he worried more about his cards than about the operation of the *Robert E. Lee.* You see, he wasn't sure of his cards. END

Helium: $2,500 to 1½ Cents

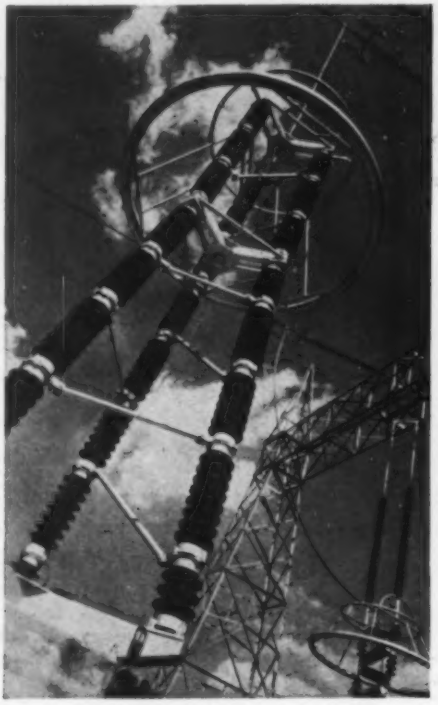
HELIUM cost $2,500 a cubic foot when it was a laboratory phenomenon 30 years ago. Today 1½ cents buys a cubic foot of helium extracted from natural gas at the government's four plants in Kansas, New Mexico, and Texas.



Mechanical Butterfly

When Hollywood couldn't deliver a trained butterfly called for in a movie script, studio mechanics came up with this metal one, wired for action.

The wings are made to flutter by remote control, out of camera range. As shown at right above, two thin metal strips are attached to the hinged wings of the imitation insect. Four inches below the wings, the strips are joined and attached to a piano wire running through a long copper tube. Pull the wire, and the butterfly performs. This model represents the butterfly poised upon a flower, as in the picture at left. Another version, attached to a traveling boom, simulates a butterfly in flight.



Thunderbolt Tower

Giant "tripod" at left is world's largest lightning arrester, its three 29-foot-high legs designed to carry thunderbolts harmlessly to the ground. Constructed by Westinghouse, it is installed on a 500,000-volt test transmission line in Ohio to protect delicate equipment. One of two other arresters is visible at lower right.

Guess Which Is Real

Look alike, don't they, these two star rubies? But the one on the left is a natural stone, valued at $12,000, while the one on the middle finger is synthetic, worth about $600. Developed for industrial use, synthetic star rubies and sapphires will soon be on the market as jewelry.

Chopping a hole in a cloud. A few pounds of dry ice were enough to clear this rift in an ice-forming cloud. It is 15 miles long and three miles wide—twice the size of Manhattan Island. An airplane can drop into the opening without collecting ice on its wings or control surfaces.

"Sanding Roads" for Planes

SCIENCE'S snow makers are crossing ice off the list of flying dangers by removing the supercooled clouds that cause the ice to form on wings and control surfaces. They "sand" the clouds with ordinary dry ice—and in 15 minutes there is a hole big enough for a plane to land through.

Capt. Clarence N. Chamberlain, Jr., pilot of the Air Force plane used in the first cloud-boring test, said, "The hole looked like someone had taken a giant shovel and scooped out a large section of the cloud."

As reported in *Popular Science Monthly* last June, prevention of airplane icing was one of the many developments expected from the method of weather control discovered by Dr. Irving Langmuir and Vincent J. Schaefer of the General Electric Co. (see "The War Against Hail," PSM June '47, p. 82). This method already has brought rain to drought-struck areas in Illinois and Arizona, and Dr. Langmuir believes it can be adapted to change the entire winter climate of large sections of the country. It may also prevent costly hailstorms.

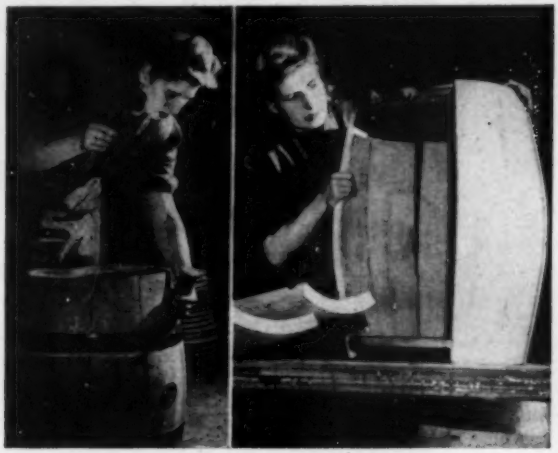
Schaefer is now working on a gun to shoot dry-ice bullets straight ahead from the nose of an airplane flying inside an ice-forming cloud. The bullets would continuously clear an ice-free path for the plane. The dry ice would change the cloud, composed of very tiny droplets of water below the freezing temperature but still unfrozen, into snow by chilling the droplets until they froze. Once started, the reaction would keep going by itself, and the cloud would disappear into snowflakes. The research program, called "Project Cirrus," is being sponsored jointly by the Army Signal Corps, Navy, Air Force, and General Electric.

Underwater Television

THE bottom of Bikini lagoon was televised during a recent scientific resurvey of the atomic bomb test area. Above left the television camera is shown inside its steel housing. With the cover bolted on, underwater scenes were photographed through glass panel in the center. Television receiving equipment was installed on a submarine on the surface where scientists watched the screen, which resembled a window in an aquarium. Scene above right shows a tropical fish swimming in front of lens; lines and debris from sunken target ship are in background. Camera used only natural light.

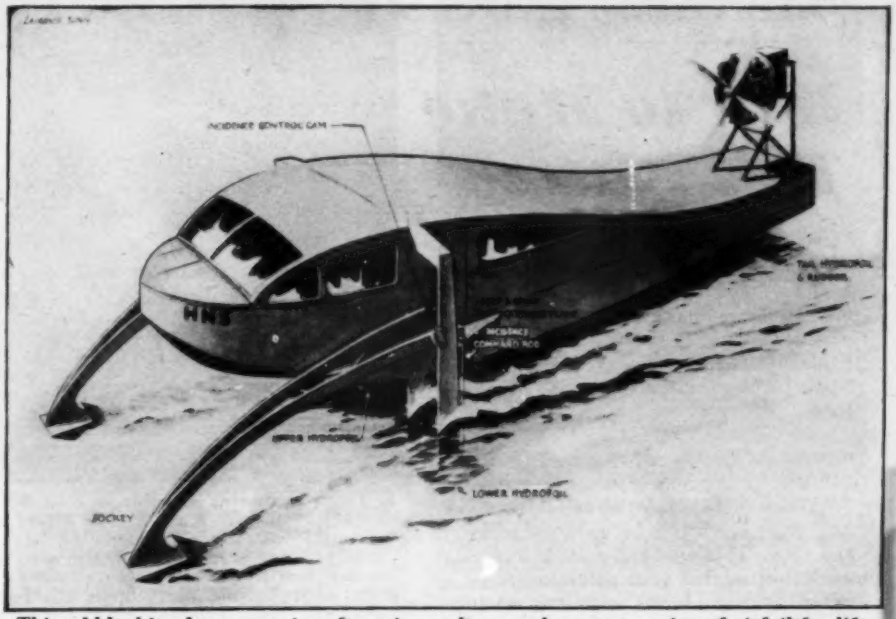
Sheets Warm Beds

THIS new low-priced electric bed warmer, developed by Westinghouse, works like an electric blanket, but costs less because the coils are sewed into muslin sheeting. The electric sheet is placed on top of the regular sheets and covered with an ordinary blanket. An ornamental "powder box" holds the automatic control for even warmth.



Barrel Comes Apart

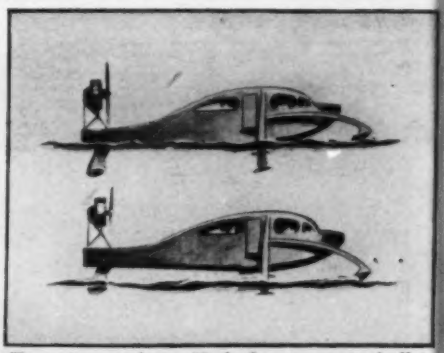
FACED with the high freight cost of returning empty barrels, the British have come out with a collapsible model. It is assembled by fitting 10 oak-lined, laminated-plywood staves into the grooves in the ends (right above). The job is completed by hammering hoops home (left above). To collapse the barrel, hoops are knocked off.



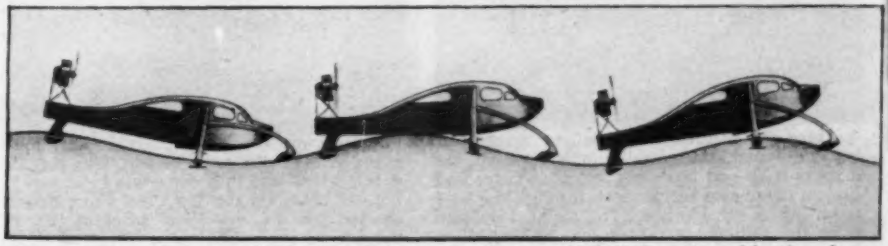
This odd-looking boat uses aircraft engine and prop, plus water version of airfoil for lift.

Buglike Boat Rides the Waves

THE "feelers" jutting out from this novel boat follow the ups and downs of waves and troughs. In turn these "jockey" skids change the angle of the hydrofoils to provide extra lift so that the Hydrofin boat rides the wave crests in rough water. The result is a smoother, faster ride, according to the craft's British inventor, Christopher Hook. The first commercial model, expected to be in coastal service early next year, will be 30 feet long, and will accommodate a dozen passengers plus a crew of two.



Top picture shows Hydrofin at rest, its hull in the water. In lower picture it gathers momentum and hydrofoils lift the hull out of the water, cutting water drag and adding speed.



These pictures show how the Hydrofin climbs even the short waves of choppy seas as a car would climb a hill. The varying angles of the underwater hydrofoils, activated by the advance team of jockey beams, do the job. Outboard aero engine is an Armstrong-Siddeley Cheetah.

MECHANICS OF LIVING

How to Make Two Bits

THE coins you jingle in your pocket may not buy much nowadays, but to Uncle Sam they are big business. Only by using modern mass-production methods can his money factories keep up with the demand.

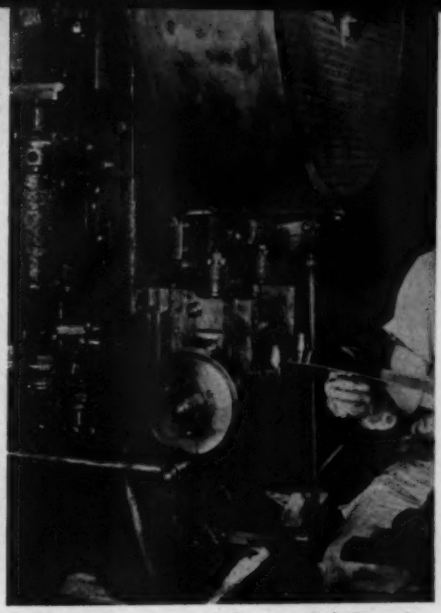
Making a quarter today doesn't take too much hand work—unless you're a counterfeiter. Then you'd appreciate that making money the mint's way is a job of fine craftsmanship. More than two billion coins from half dollars to pennies, valued at more than 77 million dollars, were turned out last year. And every one had to be up to par in weight and alloy. That's not just pride in fine metalwork, but so that your nickel won't be rejected by pay phones, cigarette machines, turnstiles, and other coin devices.

1. From a glowing crucible, a mint worker dips alloy and pours it into molds. When cool, the metal will be in the form of "coinage ingots" 12 inches long, two inches wide, and one-half inch thick. The alloy consists of nine parts silver to one part copper—the copper makes the coins tougher. Each ingot must meet rigid assay tests for purity.

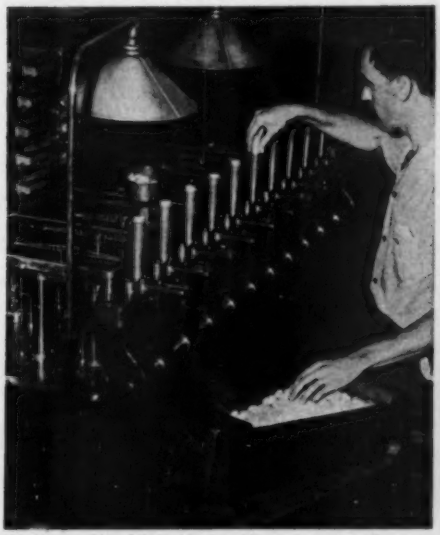
4. Here the output of the cutting machine is being dumped into a riddle, or large sieve. As it rocks back and forth any scraps of silver and broken or off-size blanks drop through the wire mesh into a salvage box. The metal, hardened from the rolling, next goes into an annealing furnace where it is softened by subjection to high temperatures. Cleaning comes next.

5. Emerging wet from a chemical cleaning solution, the blanks are dumped into this drier. A few whirls and they come out gleaming, looking like silver for the first time. From here they are fed into an "upsetting" machine that gives the blanks the raised rims. Precision again is paramount, for with uneven rims the finished coins would not stack properly.

2. The metal starts on its way to become a quarter. Here the coinage ingots are passed through rolling machines that reduce their thickness to about that of a finished coin. The process results in strips eight to 10 feet long, and a little wider than two coins. At this early stage of production the working metal resembles zinc more than it does silver.

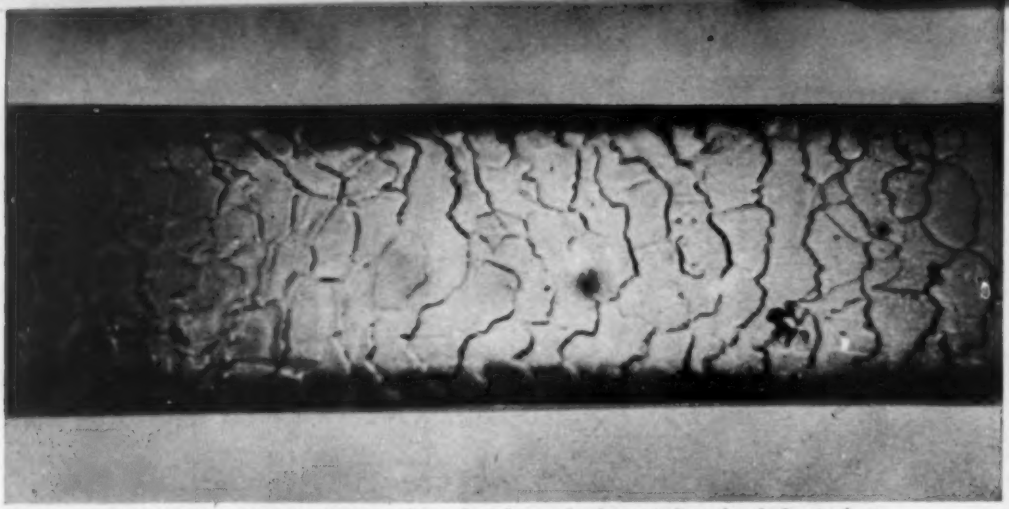


3. The strips of metal then are fed through a cutting machine that punches out coin blanks, two at a time. To insure maximum uniformity, grippers hold each strip rigidly in place as the cutters strike. There is no waste anywhere along the production line of Uncle Sam's mints. Scraps left over after cutting, called "clippings," are remelted and used later.



6. As a double check, time out is taken to weigh the blanks in these automatic scales. Although the blanks are weighed individually, one machine can handle 9,000 an hour. Standard weight for a quarter is 96.45 grains. With deft fingers the operator picks out any coin that varies by more than three grains. These rejects are put in a box on top of the machine.

7. Here come the quarters—finished coins at last. The press shown here gulps blanks through opening at upper left and ejects its two-bit product into box at right foreground. Eighty tons of pressure squeeze the blanks between steel dies to make the head and tail designs; at the same time a collar puts reeding around the edge. Capacity is 100 coins a minute.



Important clues in hair identification are the scales, shown above magnified 500 diameters. These are of the "shingle" type; others are found completely encircling the shaft. Authorities recognize that human beings have as many as eight varieties of hair scales.

Catching Criminals By a Hair

How laboratory research "fingerprints" human hair as an aid to scientific identification.

By Andrew R. Boone

A DEFENDANT was on trial for assault. The jury was in doubt when Dr. Paul L. Kirk, of the University of California's crime laboratory, showed them a pair of similar hairs wound around a glass bobbin. One hair was found on the scene of the crime; the other taken from the accused.

"I can't prove that these two hairs are from the same head," said Dr. Kirk. But then he went on and demonstrated point after point of identity between the two strands.

The verdict was "guilty."

This was not the first time that the scientific study of human hair has helped bring the guilty to justice or clear those falsely accused. Dr. Kirk, a professor of biochemistry, began his study of hair some 20 years ago. Since that time he has worked in his laboratory on more than 150 cases, representing crimes ranging from petty larceny to murder. And although Dr. Kirk is the first to admit that hair is not yet a positive means of identification, his courtroom testimony never has been discredited.

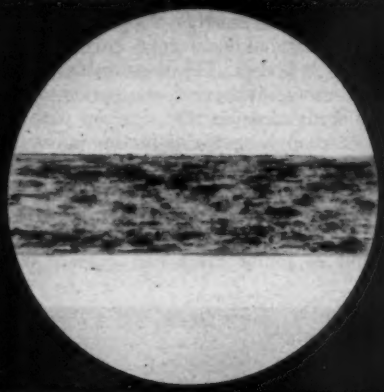
To describe a hair scientifically you must look inside it, and study its structure—particularly when a man's liberty or life is at stake. A good head of hair contains about 130,000 strands. They assume many shapes, the majority being oval in form.

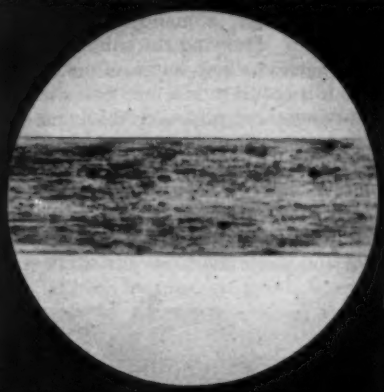
Their structure is complex. A hair is divided into three parts: scale, cortex, and medulla. The scales appear as tiny shingles, several hundred to the inch. The cortex, immediately under the surface scales, is composed of a group of tiny elongated fibrils. The medulla (not always present), is a pithy core of cells interspersed with diffused pigment, pigment cells, and air spaces, lying along the central part of the shaft.

And to confuse the hair detective, the hairs on the crown of a man's head are not the same as those on the nape of his neck. A permanent wave can result in two spots of a single hair being different in both appearance and composition. Dyeing alters surface hair color but not internal-pigment color, while bleaching does both.

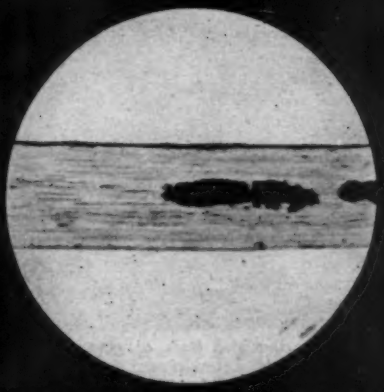
Refractive index (the ability to slow up

HOW MICROSCOPIC COMPARISON MATCHES UP HUMAN HAIRS



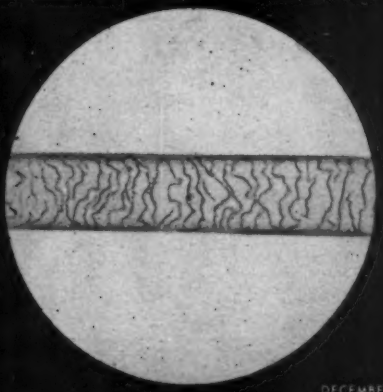


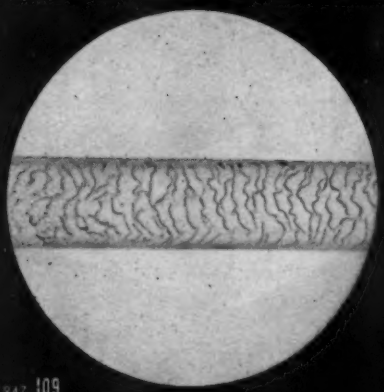
A HAIR TELLS ITS STORY. The strand, left above, taken from an axe used in murdering a brown-haired woman, reveals a granulated pigmentation. Note how closely pigment of specimen, right above, taken from victim's head, matches sample at left. An important step has been made in matching the hairs.



AXE YIELDS ANOTHER CLUE. Further examination of specimen, left above, from death weapon reveals fragmental medullary material, the pithy core found in some head hair. Strand of the woman's hair shown right above has same type of medulla, forging another link in the chain of scientific evidence.

EVIDENCE PILES UP. When microscope is trained on cast of hair taken from axe, left below, its scale pattern stands out. Examination of victim's hair, right below, shows it checkered by same wavy, shinglelike scales. Although not conclusive, these points of hair identity helped convict a murderer.





light passed through it) averages higher in women's hair than in men's, which helps the hair sleuth. Knowing the subject's race, Kirk can examine a hair, and four out of five times tell if it comes from a man or a woman.

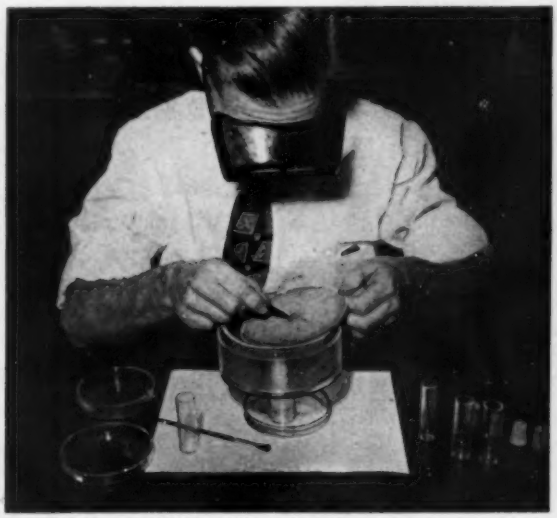
Identifying the guilty and absolving the innocent by means of hair, however, is not yet a job for the cops. A vast store of knowledge must first be acquired by investigators such as Kirk. Comprehensive files including nearly all types of human hair must be built up and made available for study.

Kirk has already filed 100 hairs each from 400 people, mostly willing students at the University of California, covering all parts of their bodies. He plans to obtain samples from some of them over a period of 20 years to study changes that develop with age.

Although scores of factors enter into the hair identification picture, Dr. Kirk depends largely on the following major points to prove his cases:

Color. This is the first and most obvious, and in many cases can quickly eliminate

1. Searching for telltale hairs, Dr. Kirk goes over a bedspread with a special vacuum attachment. Hairs will be caught on a porous disk through which air but not dirt can pass.



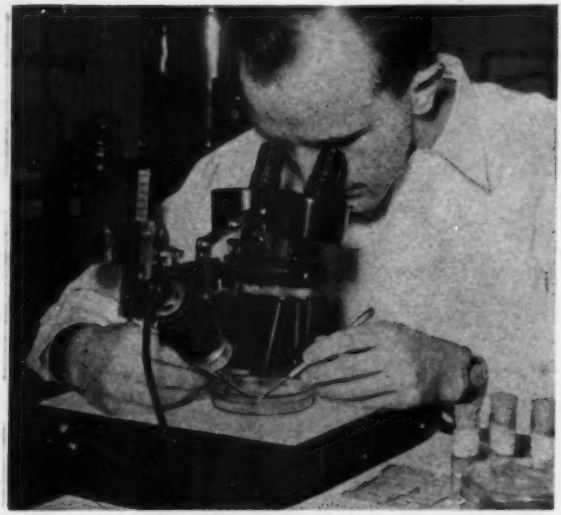
2. The dirt and hair collected is then examined through a low-power enlarging lens. The hairs are carefully removed with tweezers and prepared for microscopic and other studies.

4. After drying, short hairs are then cut into pieces one millimeter long for mounting on slides. Two ordinary razor blades, set parallel on a thin brass block, do the job efficiently.

5. Hairs of different density will be separated when immersed in a mixture of two liquids of different specific gravity. Here Dr. Kirk is taking a density reading off a test tube.

suspicion from a person. But color must be interpreted with caution, for shades of hair vary widely on a single head, such as from blonde to brown on a red head. Kirk hopes that an absolute color chart for hair may be worked out, and that the chemical identity or differences of pigments may be established as a check on color.

Diameter. Before assigning any great significance to the fineness or coarseness of an individual hair, accurate measurements of the maximum diameter is taken with a calibrated ocular micrometer, and of the minimum diameter with a calibrated fine adjustment on a microscope.



3. A microscope is needed to detect some fine hairs among the debris of dandruff, oil, and dust. Once isolated, the hairs are washed in a mixture of equal parts of ether and alcohol.

6. Enlarged photographs, some as high as 500 diameters, are used for further study and courtroom presentation. Dr. Kirk uses small camera, placed lens down on horizontal mount.

Scale Count. Scores of counts must be taken along one or several hairs to obtain an average. If the average count on your hair, for instance, is 24 scales for each two-tenths of a millimeter of length, all hair averaging less than 22 or more than 26 would be considered as coming from someone else.

Scale Picture. This means the shape, regularity or irregularity of sizes, edges, and any other features revealed through the microscope. Generally, hair scales of one head follow the same general pattern, and hairs have been identified on this basis alone.

Pigment. This is one of the best points of evidence in the identification of hair. Both density and distribution play a part. "In general," Kirk says, "the pigment density is inversely proportional to the amount of light that can be transmitted through the hair." Very light blonde or gray hair is of minimum density. Distribution of pigment granules is also important.

Medullation. The presence or absence of a pithy core (medulla) in hair is not considered of great significance. However, since some people have much medulla in their hair, and others little or none, its study is sometimes of value.

Refractive Index. The varying ability of hair to slow up light serves both in matching hairs and in determining race and sex.

Double Refraction. All hair is capable of this optical phenomenon to some degree. When two hairs of the same diameter are examined with polarized light, however, those from the same source usually show the same interference colors; those of different origins, different colors.

Density. The specific gravity of hair often differs among individuals, ranging from 1.30 to 1.39. It will also differ between medullated and nonmedullated hair of the same person.

Other factors may prove of consequence, such as tensile strength, stretch coefficient, and electrical characteristics. Permanent-waved hair, for instance, stretches readily as compared to untreated hair. Perhaps hair of one individual will stretch farther than hair of another. So far, little investigation has been done along these lines.

Someday, Dr. Kirk believes, further research by physicists and chemists may make hair the equal of fingerprints as a means of positive identification. END

Operating in Safety

A NEW grounding device has been developed for use in hospital operating rooms to guard against explosions caused by static electricity touching off the highly volatile anesthetic gases.

Heart of the device is a bronze box (shown in inset) that is set flush in the floor and grounded to the nearest water pipe. In the center, six socket receptacles receive the jack-plug ends of bead chains covered with plastic insulation. At other ends of the chains are clamps for attachment to objects such as anesthesia machine, operating and instrument tables, nurses, and patient.

Installation of new grounding system is shown in picture above. Arrows indicate where device is set into the floor.

Jet Propels Bicycle

SOUNDING off like a squadron of fighter planes, this jet-powered bike can make 25 miles an hour—but not for long, because of rapid fuel consumption. The three power units shown are miniature, gasoline-operated jet engines used for powering model aircraft and racing cars. This jet bike was made for exhibition purposes by the Aeromarine Co., of Vandalia, Ohio, but has not been produced commercially.

Tiny Loom Does Fast Job

THIS typewriter-size rayon hand loom makes samples of new fabrics in a few hours that would take weeks if woven at a mill. It is operated by Mooresville Mills, of New York City, to whom manufacturers bring ideas for new patterns and designs. The guide-woven sample can be tried out in the trade before the design goes into production. These samples are credited with selling 10 million yards of goods.

This Month's Pin-up

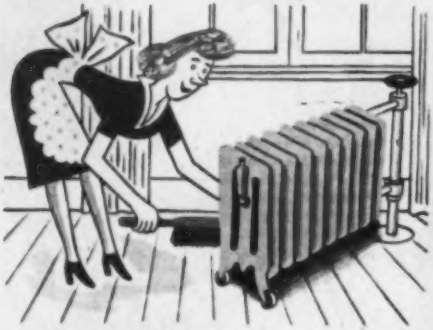
CONSOLIDATED'S slim XB-46, developed for the Air Force, has a speed of more than 480 m.p.h. It is powered by four GE J-35 turbojets, two in each nacelle. Knife-thin wings have span of 113 feet; the fuselage is 106 feet long, holds 10 tons of bombs.

I'd like to see them make . . .

Cartoons by Syd Landi

Everybody has his own pet idea of some gadget he would like to see in general use. What is YOURS? *Popular Science Monthly* will pay $5.00 for every such suggestion that it accepts for publication. Contributions cannot be acknowledged or returned.

Spigots for Stoves. To make it easier to add water to food as it cooks on the stove, Claire Caswell, of Austin, Tex., would like ranges equipped with flexible, fingertip-controlled hoses connected to a water supply.



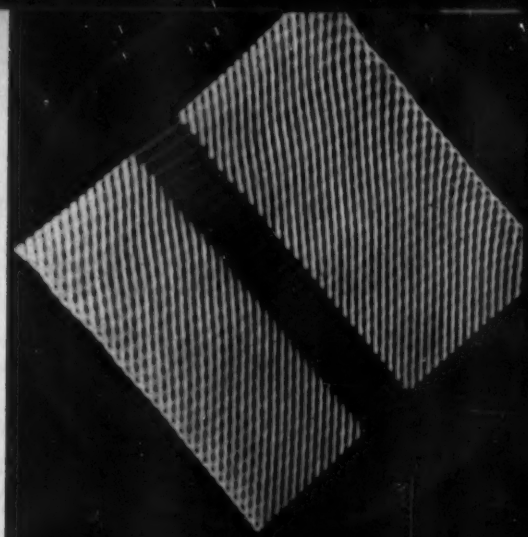
Swinging Radiators. Pivoted at one end and with wheels at the other, they could be swung out from the wall for easier cleaning, painting or papering, says Mrs. Madeleine Thompson, of Merchantville, N. J.

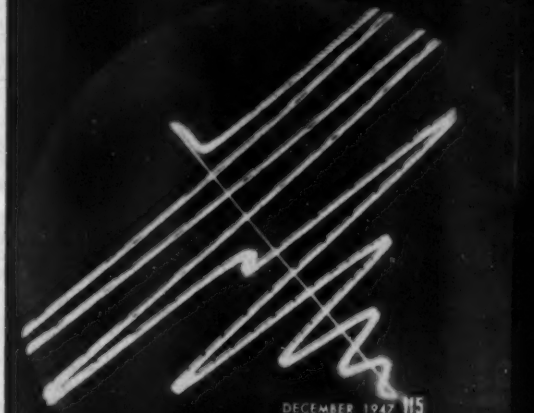
Shoppers' Aid. To let shoppers look at their leisure until ready to buy, Raymond Holtz, of San Francisco, suggests they be given tags saying "just looking" on one side and "ready to buy" on the other.

Self-Finding Keyhole. A funnel-like extension on the front-door keyhole would help guide key into the lock and put an end to fumbling in the dark, claims R. Pretorius, of Luderitz, South-West Africa.

Flouring Pin. A hollow rolling pin containing flour and dispensing it through tiny holes as it is turned would flour-dust the dough while rolling it at the same time, declares Cecile Ludolph, of Marshall, Tex.

Twirling the dial of the television test set, above, creates an infinite variety of patterns for designers. Three examples are at right.





Even Necktie Designers Can Use Electrons

FABRIC designers in search of inspiration may well turn to a television receiver, General Electric engineers suggest.

When they test cathode-ray tubes for modern sets by applying varying voltages, the engineers have found that the flying electron beam often sketches traceries of striking beauty upon the luminescent viewing screen. Ranging from random squiggles to intricate geometrical lacework, the designs offer fascinating possibilities for dresses, scarves, ties and draperies.

Small, portable test sets, currently available, are suited to apply this new scientific aid to art. Simply by twirling a dial, a seeker after new patterns can conjure up an infinite variety. Through the magic of electronics, the marvelous symmetry of motions resulting from the complex interplay of natural forces becomes visible to human eyes. Captured by photography, as at right, the fleeting images may be preserved for subsequent transfer to fabric.

Turning a Watch Inside Out

HERE is how you can take a watch—or an aircraft engine—apart and put it together again without even a screwdriver. It's all done with transparent plastic, printer's ink—and painstaking techniques. Using them, the Trans-Vision process can turn a machine inside out for you and not lose a screw.

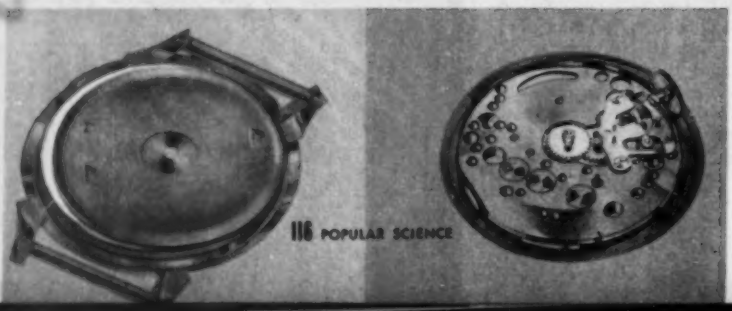
Here we see the process, developed by Milprint, Inc., applied to watches. Each page of this booklet, prepared for the Bulova School of Watchmaking, has drawings of one layer of a watch. Every time you turn a page, you peel off a layer, like a layer of an onion.

At left is shown the complete watch, enclosed in its case, as it appears through the transparent opening of the cover. Lift the cover and you lift off the upper case. As each page is turned, the underside of the section removed can be seen on the left-hand page, the top of the next layer on the right. Thus, while the watch is taken apart on the right side, it is put together again on the left.

Printing and binding one of these booklets is an exacting job. Each picture must be printed, by rotogravure, on the back of the sheet, so that the ink is protected by the transparent paper. Pictures of the top and bottom of a layer of mechanism are printed on one sheet, which is then folded to bring the two back to back. Not only must they match, but each page must be in perfect alignment with every other page or the effect is lost.

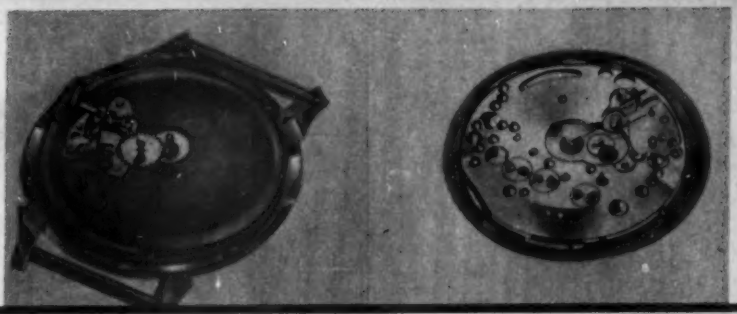
Below, the pages are turned for you—and a watch comes apart in your hands.

1 Opening the cover has already removed the upper half of the case: now the hour and minute hands are lifted off as you turn the first page, leaving the dial exposed on the next sheet. When all details have been carefully noted, the page is turned and the underside studied.

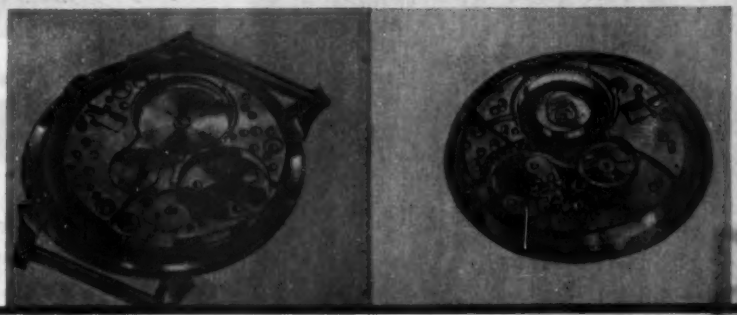


2 Now the dial has been lifted off and placed at left, face down. This uncovers the hour wheel (shown in yellow) and yoke. Since all parts are always available they can be studied at leisure.

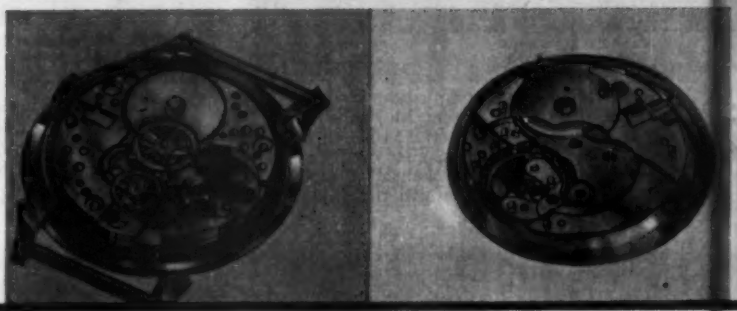
3 Now the yoke and hour wheel; crown stem; clutch, setting, and minute wheels; setting and clutch levers; and setting-lever spring have all been peeled off. This leaves the pillar plate exposed at right.



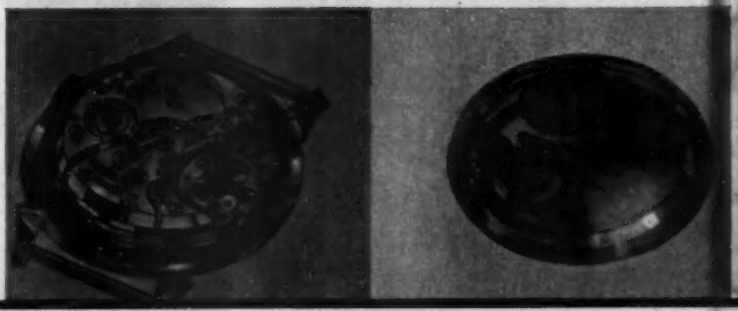
4 Another page exposes the movement side of pillar plate at left, showing barrel recess. This houses barrel, mainspring, and barrel arbor, on right page. Third, fourth and center wheels are in yellow.



5 Turning over another layer reveals, at right, the barrel bridge (at top), train-wheel bridge with train jewels (lower right), and pallet bridge with pallet-arbor jewel (lower left).



6 Now only a few pieces remain in the watch shell at right. They include the ratchet and crown wheels and the click (at top), balance bridge and wheel, the hair spring, and the roller with its jewel.



7 The watch has now been rebuilt in reverse in the left-hand column. Closing the back cover of the booklet, at right, fits the back of the case over the works. An automobile could be stripped as easily.

This saving was accomplished by substituting eight 56-inch wheels, like those shown above, for the two massive 110-inch wheels used on the main landing gear of the experimental model. Better weight distribution allows use of lower-strength runways.

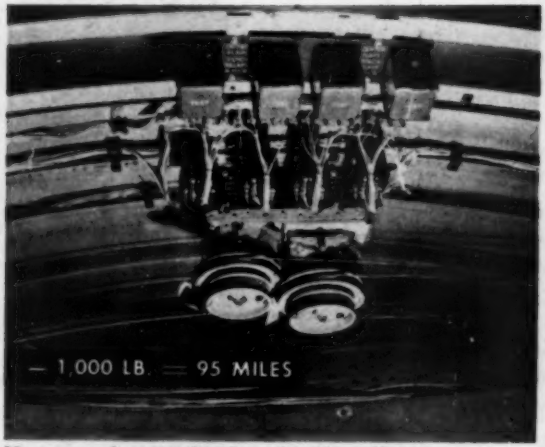
Reducing Diet

Sweating 11 tons off the big bomber by ingenious engineering techniques stretches its range 2,000 miles.

EVERY pound of weight in the Air Forces' huge six-engine B-36 bomber requires nearly a pound of fuel and oil to permit the plane to carry its peak bomb load across oceans and Arctic wastes.

That is why this 139-ton aerial giant has been on a strict engineering "diet" from its drawing board days through the assembly-line and flight-testing phases at Consoli-

Artificial aging of aluminum alloy in a furnace (above) saved 6,750 lb. because increased strength made it possible to reduce the amount used. Substitution of magnesium alloy for aluminum in various places netted an additional saving of 1,900 lb.



More pounds were shed by using these lightweight electromechanical synchronizers to co-ordinate the movement of the B-36's three pairs of wing flaps. Often such pound-saving techniques improve the efficiency of the parts to which they are applied.

for the B-36

dated Vultee's plant in Fort Worth, Tex.

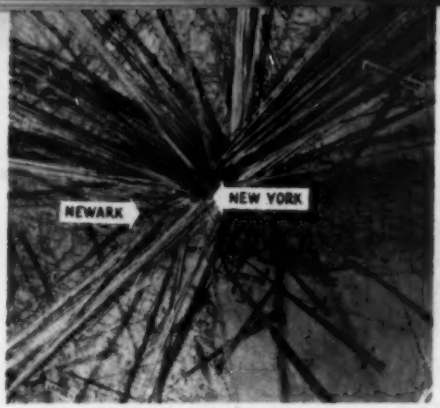
So far, ingenious engineering has sweated more than 11 tons off the B-36's original design—a saving that, if utilized for fuel and oil, would increase its range by more than 2,000 miles. In actual production, however, this weight saving has permitted the installation of tons of new devices and additional equipment developed during the war, while keeping within the 139-ton maximum. That maximum is imposed by the requirements of the B-36's job—carrying 10,000 lb. of bombs 10,000 miles, or a peak load of 72,000 lb., its capacity when flying to a target at shorter range. END

Weight-conscious Convair engineers developed a lightweight alternating-current electrical system to replace direct current in the B-36, thus lopping off another ton. This generator delivers 50 percent more power per pound than a comparable DC machine.

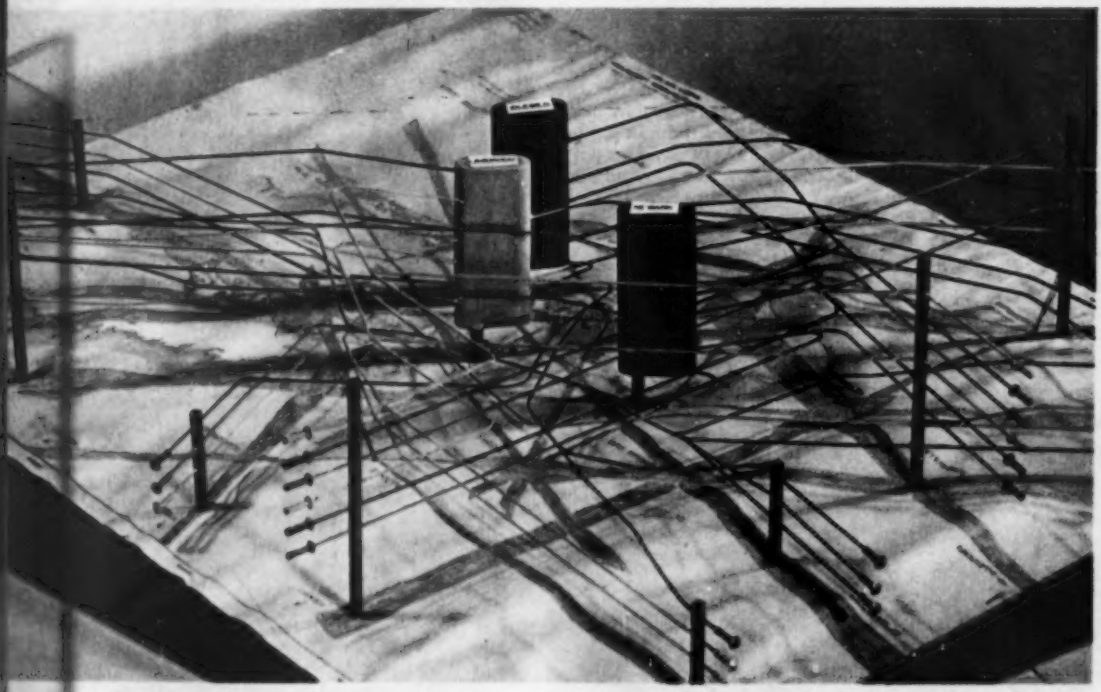
Lightweight containers for fire-extinguishing system did their bit. Substitution of methyl bromide for carbon dioxide also permits the use of smaller quantity of gas stored at a lower pressure. As a result, storage tanks and conducting lines can be made lighter.

An integral fuel-tank system instead of the standard cells or bags contributed this saving. Here bullet-sealing rubber blanket is being attached to outboard tank as protection. Inboard tanks are not sealed, since they would be empty before reaching target.

Switchyard for Air Liners



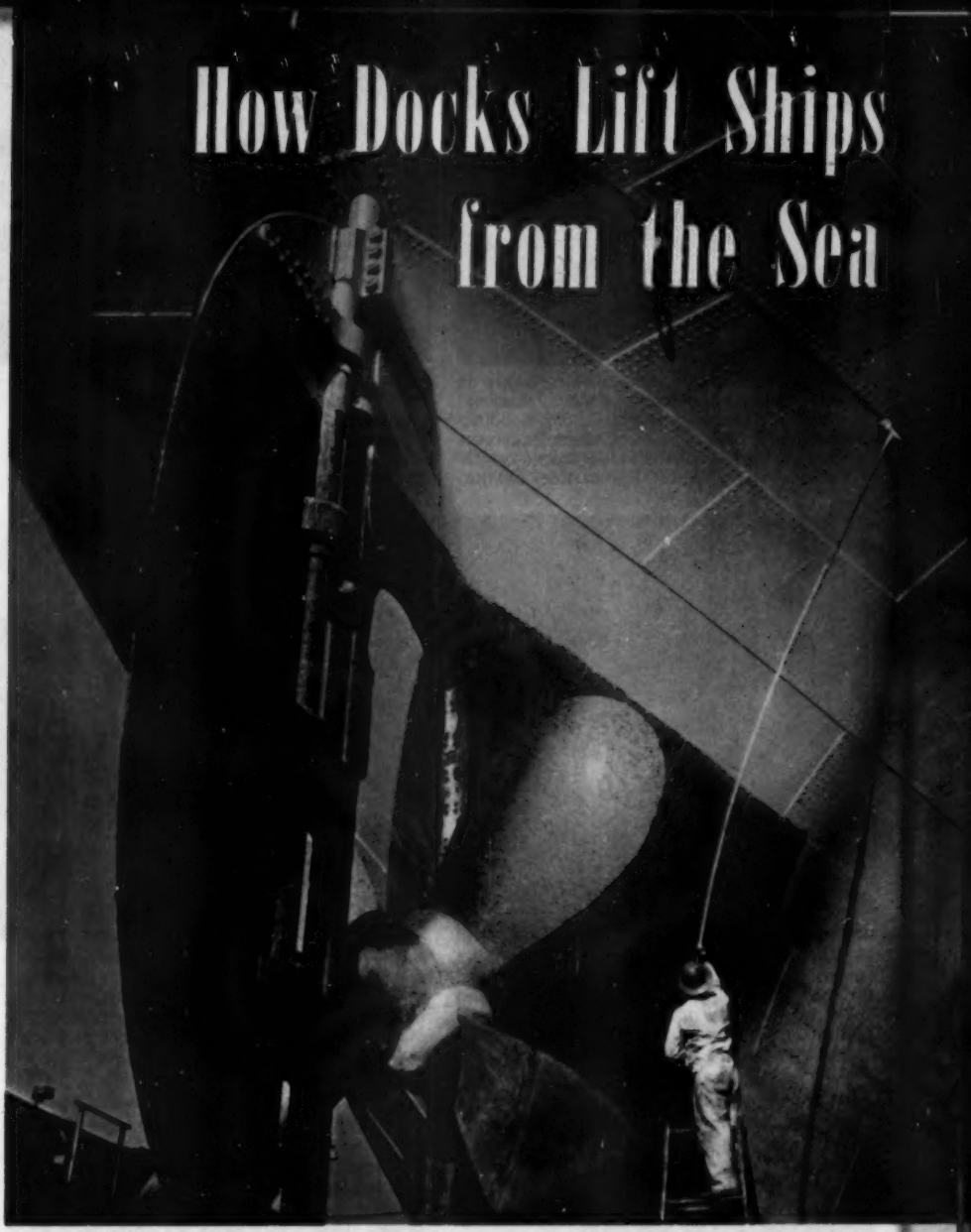
The Problem: The mess of string on a map (above, at right) at the Airborne Instruments Laboratory in Mineola, N. Y., shows New York City's air-traffic problem. There are almost 600 strands, representing that many scheduled air-line flights every 24 hours. In good weather, traffic control is no problem; when ceiling and visibility are low, it's a prime headache. What can be done to remedy it?



A Solution: This model, made of wire, illustrates one proposal made by the laboratory to the Air Transport Association to double the number of planes handled in the metropolitan area under marginal weather conditions. Viewed from the northwest, it shows nonconflicting incoming and outgoing routes provided for each of the area's three major airports. Planes using the routes would have the safeguard of both horizontal and vertical separation.

The three columns—red for Newark Airport, yellow for LaGuardia, blue for Idlewild—are "stack orbits" where planes would loaf until they could land. In landing, a plane would leave its orbit and fly outbound on a "timing loop" designed to insure adequate spacing with the plane ahead. The plan contemplates use of ground radar to assist in this time spacing. Outgoing routes split off after take-off to allow rapid dispersal of traffic. Arrows attached to the ends of the wires indicate the proposed routes and show directions of flight.

How Docks Lift Ships from the Sea



Dry-docked ship is painted to repel barnacles, protect hull from rust and galvanic action.

ONLY part of a big ship's lifetime is spent in the water. Periodically she must be dry-docked, usually twice a year, to repaint her bottom and effect any repairs that may be needed to maintain her hull in seaworthy condition. This may be done either in a graving dock—a basin that can be shut off from the sea and pumped dry—or, more spectacularly, in a floating dry dock, which actually lifts the vessel bodily from the water.

How a floating dry dock raises an ocean vessel high and dry is shown on the following pages in pictures made by Hubert Luckett, PSM staff photographer, during the recent dry-docking of the 492-foot S.S. *Mormactide* in No. 7 dock of the Todd Shipyards Corporation at Brooklyn, N. Y.

1. S.S. *Mormactide*, passenger-cargo ship of 17,600 tons displacement, enters floating dry dock for periodic overhaul. By flooding its buoyancy compartments, dock has been lowered far enough to provide ample depth of water over its center line of keel blocks.

2. Deck winches at bow of ship take up lines made fast ashore and slowly draw vessel into place, under control of tugboats holding back on stern lines. Dockmaster with microphone, in foreground, directs entire operation through system of loudspeakers.

5. In control room on dock, operator flicks electric switches actuating pumps, valves. Pumps empty buoyancy compartments and dock rises at rate of one foot in 45 seconds, lifting the big ship bodily. Water around vessel spills from open ends of rising dock.

6. An overhauling crew swarms into dock as last of water drains out, leaving ship high and dry on the blocks. Using long-handled scrapers and wire brushes, men remove all traces of rust and marine growth from ship's bottom in preparation for repainting job.

Built during the war to U. S. Navy design, this 622-foot-long steel dock has a lifting capacity of 18,000 tons. Its exceptional width, 96 feet, admits ships of unusually wide beam. Shaped like a box without a cover or ends, this dock has 16 buoyancy compartments in its side walls.

First step in lifting a ship from the sea is to lower the dock by flooding these compartments. A ship can then be floated in at the open end, over a line of massive wooden blocks extending along the center to support the vessel's keel. These are submerged 28 feet beneath the water at maximum operating depth. Movable bilge blocks, "tailor-made" in advance from plans of the particular vessel to be docked, are brought up against her sides after she is in place to help hold her securely while she is out of the water.

Pumps now empty the buoyancy tanks and the lightened dry dock rises, lifting the ship from her natural element. Water within the dock spills from its open ends as it rises, until all has drained out. As soon as the ship and the floor of the dock are high and dry, workmen swarm into the dock to put the vessel in first-class condition in the shortest possible time. Depending on the amount of work to be done, the ship may spend anywhere from a day to several months in dry dock.

A typical hull-painting job calls for three coats, each with a special purpose. Light

3. Measurements with this giant "ruler" help center vessel in dock. After she reaches correct fore-and-aft position, men on dock use power capstans and block-and-tackle rig to move her sideward until she is lined up over the blocks that will support her keel.

4. Hand cranks along side of dock operate chain-and-pulley gear that moves bilge blocks up against each side of ship, to aid keel blocks in holding her securely while she is out of water. Bilge blocks are carefully "tailored" to fit individual ships.

7. Barnacle's-eye view of bow of vessel gives unusual glimpse of underwater design of a big ship's keel as it rests on wooden blocks in dry dock. Note how successfully the ticklish job of centering the ship over the submerged keel blocks has been accomplished.

8. Inspector for marine underwriters, with hammer and flashlight, tests welding of bilge keel, or antirolling fin. When hull has passed rigid inspection for seaworthiness, and repainting is done, dry-docking operation is reversed to refloat the ship.

red anticorrosive paint protects the hull from rust. Next comes a red coat of antifouling paint, a mercurial preparation that repels barnacles and other marine growths. The third coat, a black antigalvanic compound, prevents the steel hull plates from being pitted as a result of losing metal through a process akin to electroplating. But for the compound, this would take place because bronze propellers and steel plates form a natural electric battery when immersed in salt water.

During the periodic dry-docking, a ship's hull gets a rigid inspection for seaworthiness and any necessary repairs are made, such as replacing plates found to be excessively corroded. Grounding or collision may send a ship to dry dock for more extensive repairs.

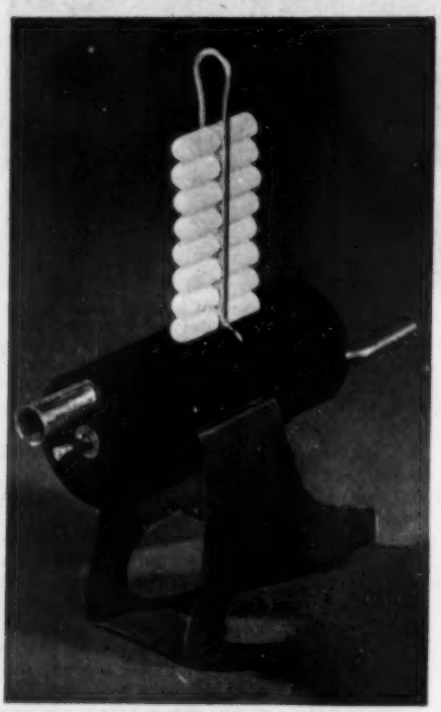
Responsibility for the handling of a ship while she is entering and leaving a dry dock falls upon the dockmaster. He used to direct the entire operation with a megaphone, but now he has the aid of a microphone and a system of loudspeakers along the dock and in its control room. The safety of the vessel depends upon his skill in bringing her to rest securely upon the blocks. Orlando Dewling, assistant dockmaster at the Brooklyn yard, who superintended the docking of the *Mormactide,* says that no ship in his charge has ever keeled over during the docking operation. When one does, he plans to look for another job. END

Plastic Toys Learn to Crawl, Wiggle and Pop

ALTHOUGH metals for toys are more plentiful now, the war-born use of plastic substitutes is still enjoying a well-earned popularity with the toy makers—and the youngsters. Here are three new recruits to the growing ranks of plastic toys.

A guiding hand is all that is needed to put Slowpoke in action. Operated by a central cam, the head, legs and tail move when the turtle is pushed. The head bobs, the legs walk, the tail wags. It is made by Samuel Eppy & Co., of New York City.

Plastic and elastic allow Swimbo to wiggle through the water like an elusive trout. A tiny crank in the nose winds a rubber band inside that gives undulating motion to the flexible, sectional body. The toy fish is made by Bantam-U. S. Toys, Inc., of N. Y.



Shooting 10 wooden pellets as rapidly as a youngster can turn the small crank in the end of its breech, this toy machine gun features a barrel of polished Bakelite. The Baldwin Manufacturing Co., of Brooklyn, N. Y., produces the realistic toy.

Chemicals Clear Fog

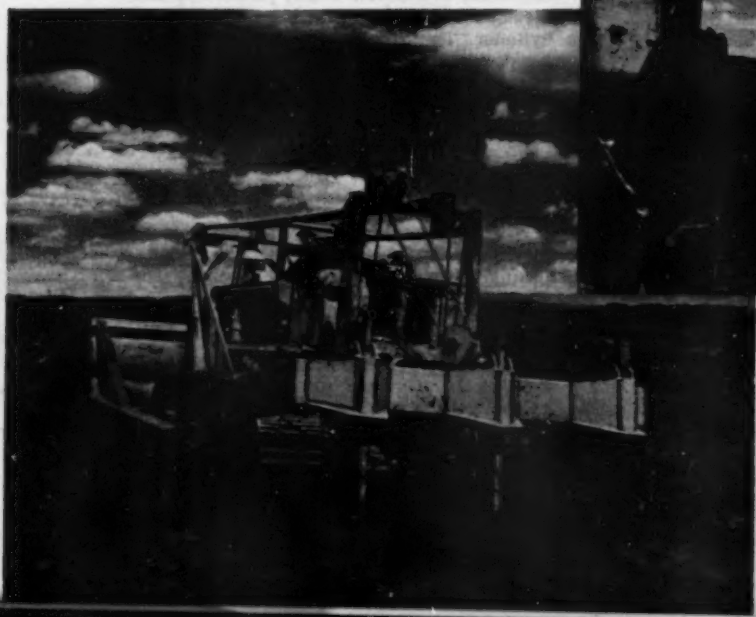
THIS giant "smudge pot" burns a mixture of chemicals at 3,000° F. to produce a vapor that disperses fog at airports. Swirling upward, the vapor lowers the humidity, clearing the fog. The 14½-foot, 3½-ton vaporizer, shown above at the Lockheed Air Terminal, Burbank, Calif., consumes 100 gal. of fuel oil and 200 pounds of chemicals an hour. Four of them can clear a square mile of fog up to 700 feet in 20 minutes.

Plow Uproots Rocks

TO SPEED the clearing of rough and rolling land for cultivation, this odd machine functions both as plow and ripper.

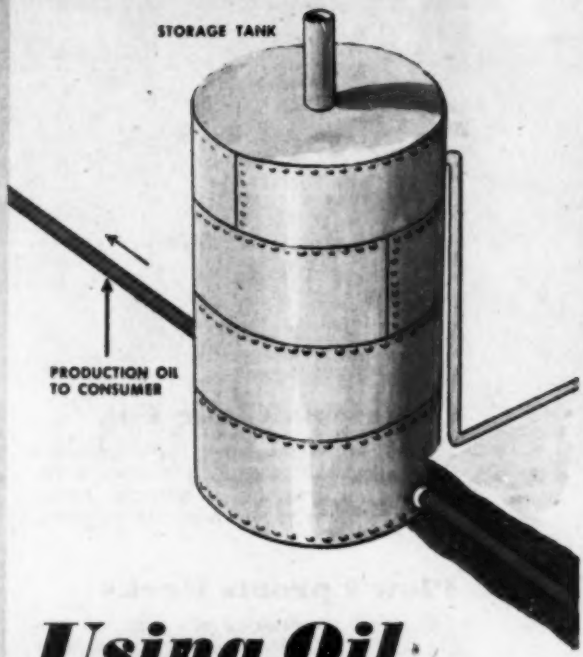
Pulled by a Diesel-powered tractor, the device has a heavy steel blade, 65 inches long, that slices horizontally through the soil from 18 to 40 inches below the surface. As it moves, the blade loosens roots and stones, bringing them to the surface.

A center point guides the blade into the earth where it automatically flattens into plowing position. In addition to combining two operations in one, the method prepares the land for cultivation without overturning and covering the topsoil.



Pulled up like a drawbridge, the big blade (above) is easily reached for servicing. Note bulldozer rig on the front end of the tractor (at left) for clearing surface obstacles.

One man can handle the "free" pump unit that is contained in this stainless-steel cylinder 2 inches thick and 10 feet long. Operator is about to lower it down well.



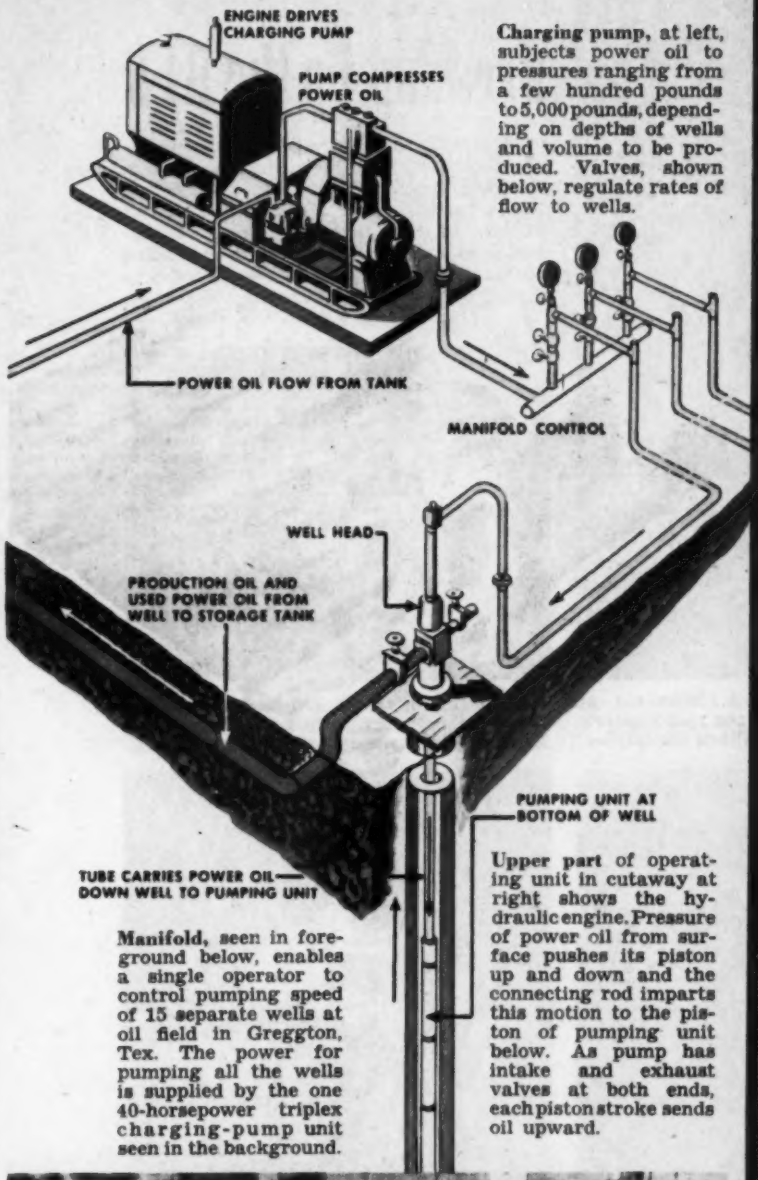
Using Oil to Pump Oil

A NEW, highly efficient, low-cost pumping system may bring new life—and profits—to oil fields abandoned as depleted. It uses oil under pressure to pump production oil up from the bottom of the deepest wells.

Developed by the Kobe Hydraulic Pump Company of California, the operating unit of the system consists of a hydraulic engine connected to a double-acting piston displacement pump, both contained in a slender steel cylinder. This "free" pump does not have to be attached to the walls of the well pipe as do ordinary pumps, but is simply floated down to the bottom of the well where it is kept firmly seated and operating by a supply of power oil pushed down a feed line under pressure.

The Kobe pump eliminates costly steel derricks and big power plants. One man at one central motor-driven charging pump above ground can feed fluid power to hydraulic units at the bottom of a dozen wells. And units can be dropped down crooked wells, or those under water—wherever the power oil can be piped.

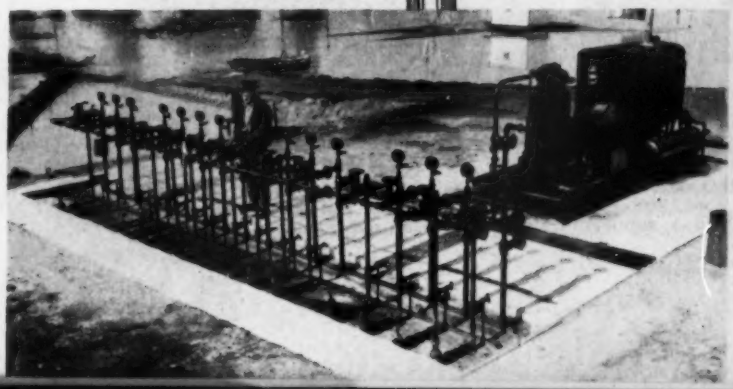
Should the well-bottom pumping unit need repairs, the operator turns a valve reversing the power flow, and the 40-lb. cylinder slides up to the top of the well where it is caught and held by steel grippers.



Charging pump, at left, subjects power oil to pressures ranging from a few hundred pounds to 5,000 pounds, depending on depths of wells and volume to be produced. Valves, shown below, regulate rates of flow to wells.

Upper part of operating unit in cutaway at right shows the hydraulic engine. Pressure of power oil from surface pushes its piston up and down and the connecting rod imparts this motion to the piston of pumping unit below. As pump has intake and exhaust valves at both ends, each piston stroke sends oil upward.

Manifold, seen in foreground below, enables a single operator to control pumping speed of 15 separate wells at oil field in Greggton, Tex. The power for pumping all the wells is supplied by the one 40-horsepower triplex charging-pump unit seen in the background.



Dressing Up the RFD

THE RFD she ain't what she used to be. Not down in southern Arizona, anyway. Thanks to enthusiasm for ingenious receptacles, the last thing a rural letter carrier expects to drop the mail into is an old-fashioned mailbox. Instead, he is confronted with everything from a converted bomb to a covered wagon. Here are some examples.

Photos by Henry Kahn, from Western Ways

This gay red-and-yellow box, mounted on half a wagon wheel, gives the real Western effect desired by many mailbox decorators.

A model of the traditional prairie schooner holds the mail here. This box belongs to Make-It-Look-Like-Something-Else school.

You have to look twice at this one. No, it isn't magic; the links of that innocent-looking chain are welded into a support.

Sheet metal, black paint, and an angle iron from an old bed rail have transformed this box into an old-fashioned street lamp.

Antique Toy Comes to Life. This project, a nice Christmas gift for preschool youngsters, has a story—and a picture—behind it. Contributor James J. O'Hara brought to PSM a print of the 17th Century Dutch painting above, called *Dancing Couple,* by Jan Steen. If you look closely, you'll see a child on the table with the toy in his (or her) hands. O'Hara said he'd like to build the toy for PSM readers to duplicate, and here it is. When you push and pull on the two sticks, the little figures lustily hammer the anvil, never missing a stroke and always in perfect step. See page 184.

CRAFTWORK
PROJECTS OF THE MONTH

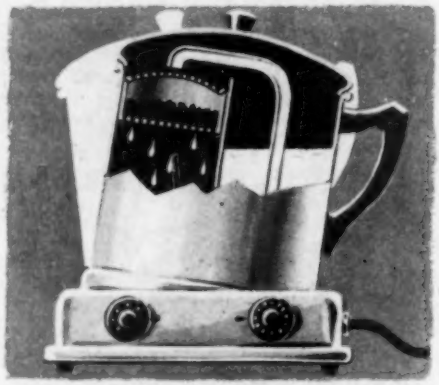
Metal Plated on Wood. That's what makes this model plane look so much like the real thing, even to the wing tanks beneath it. You can electroplate almost any surface—metal, wood, plaster, and even baby's first shoes. Turn to page 210.

Copper-on-Plastic Book Ends. Here's a perfect wedding of two materials that carry out the modern mood. Burnished copper on sparkling crystal plastic creates a pair of book ends you'll be properly proud of. Simple plans appear on page 188.

30 NEW IDEAS FROM THE INVENTORS

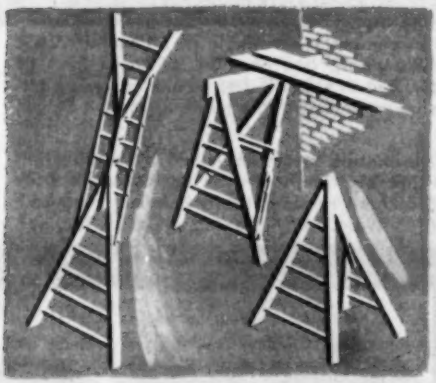
Runners Convert Wagon. Four small wheel runners quickly convert this child's wagon into a steerable sled for use in winter. Patented by Emil Lersch, of Pensacola, Fla., the ski-like, turned-up metal runners are each clamped firmly to a wheel of the wagon by a pair of side plates shaped to conform closely to the wheel's contours. In addition, angled braces between the runners and the axles provide lateral stability.

Wiper Defrosts Windshield. This wiper is designed to keep your windshield clear of ice, sleet and snow as well as rain. Invented by Reyes de Cordova, of Tracy, Calif., it is an ordinary wiper blade flanked by two electrically heated rollers that rotate against the windshield as the wiper moves back and forth, warming the glass enough to prevent freezing.



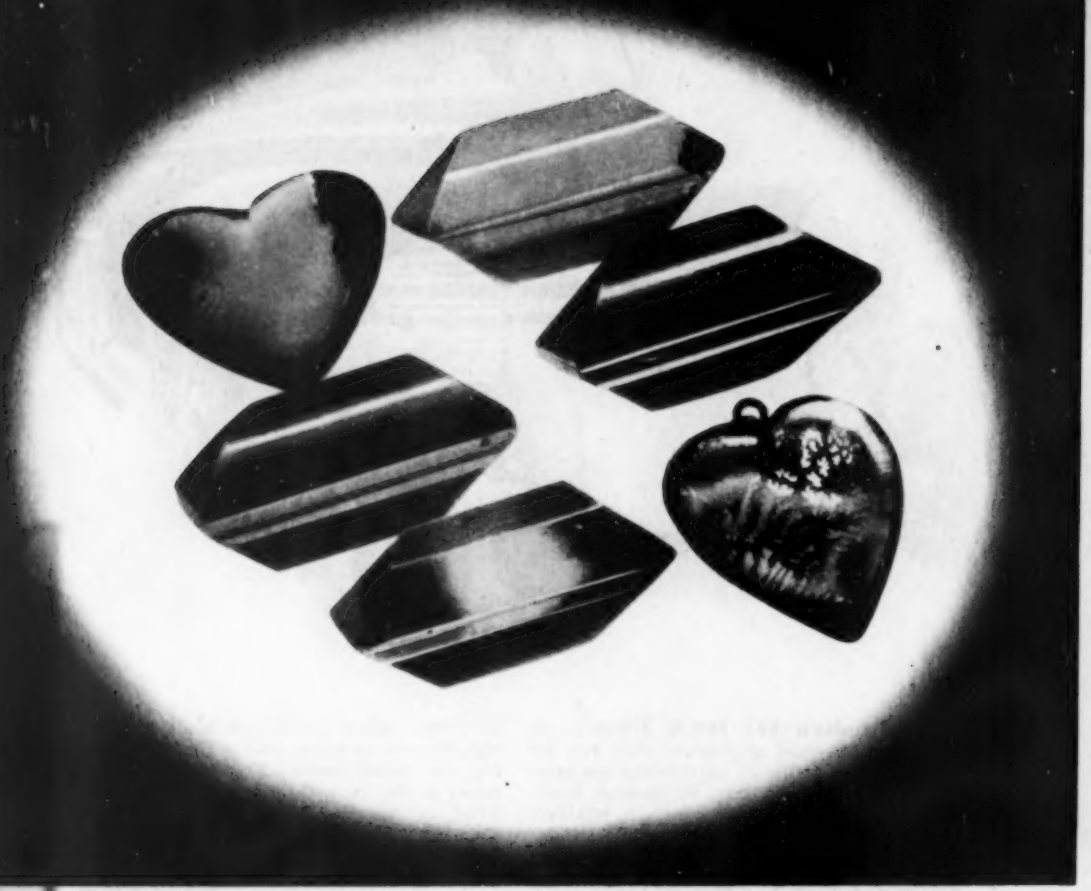
Pot Works by Itself. This is a percolator you don't have to watch. As the boiling water rises through the tube, it flows from one side of the two-chambered pot to the other. Its weight tilts the rockered hot-plate base, turning the electric heat down but not off. Patented by Julian Meier, of Detroit, Mich., the percolator can be set to go on at any time.

Car Pushes Its Own Plow. A small, lightweight snowplow that can be pushed by an ordinary automobile has been invented by Samuel Eliot, of Newton, Mass. Mounted on the front bumper, it has two screwlike, spiral sections that keep pushing the snow to either side of the car, clearing two wheel tracks. Four blades in the drum in the center dig into the snow one after another and keep the plow rotating.



Ladder Has Several Uses. This novel ladder, formed of two V-shaped runged sections joined together by a pole, serves as a stepladder when folded in the middle. Laid out flat with side braces added to folding rungs in its central section, it becomes a straight ladder. Folded another way, it is a scaffolding support. It was invented by J. Anderson, of Vancouver, B. C.

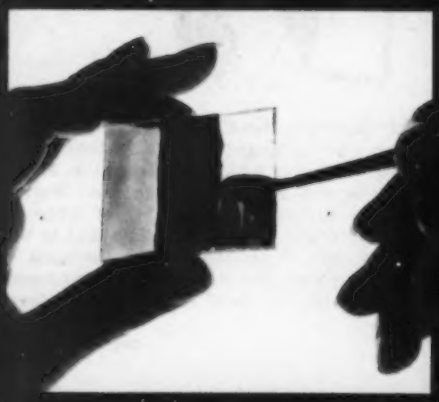
Tie Keeps Ends in Place. You'd never lose or forget the tie fastener patented by Joseph Johnson, of Islington, Mass. —it's sewed right onto the tie. Pulled through any one of a number of loops in the tie's longer end, a string attached to the shorter end is threaded back through a small hole and then wound around the nearest shirt button, holding the tie in place.



Hearts and diamonds in varied hues, as well as countless other ornaments, may be shaped from plastic laminated with colored cement. Sold in liquid form ready for use, the cement is available in all basic colors. Like paint, two or more of these may be blended to make a desired shade. The heart-shaped pendant was made as shown below.

Using a brush, flow cement liberally over one face of a sheet of plastic, being careful to coat the entire surface. Cements of different colors will produce a rainbow effect.

Laminating is accomplished by placing another plastic sheet over the cement. Slide it about, pressing out air bubbles by squeezing. Work fast; the cement dries quickly.



Laminated Plastic Works Color Magic

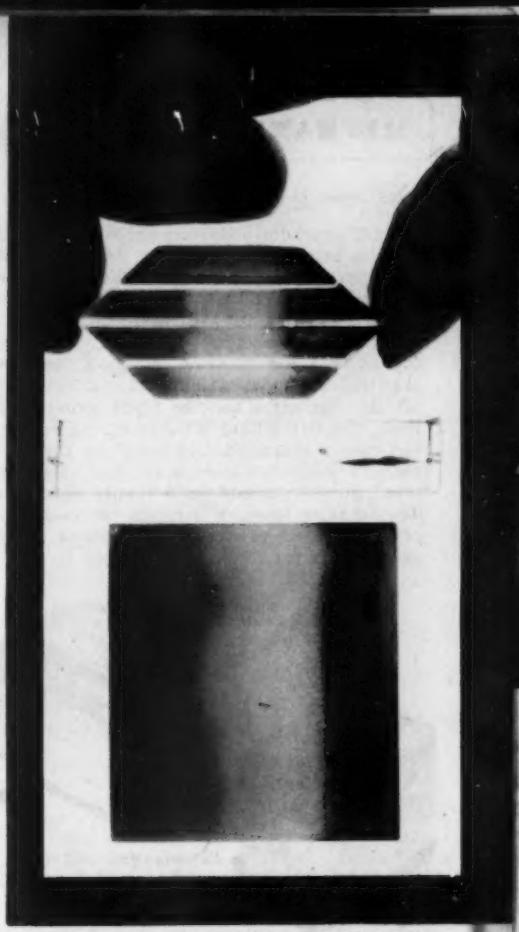
By Maurice Lannon

CEMENTS in various hues offer intriguing possibilities to the craftsman who works with plastic. Consisting of a dye in a plastic solvent, these cements are specifically intended for producing color in laminated sheets of clear plastic.

As a rule, the laminating should be done before any finishing operations, since the excess dye spills over the edges and must be sanded off. Apply the cement with a brush, flooding it on quickly so as to coat the entire surface liberally. Slide about the other sheet of plastic to blend colors and work out all air bubbles with finger pressure. Work fast, for the cement begins to dry in seconds. Solid colors may be used, or several may be applied in streaks or splotches.

If you'd like to duplicate the hearts pictured on these pages, laminate two 2" by 2" pieces of ¼" or 3/16" clear plastic. Scribe the heart from a cardboard pattern, cut out with a hacksaw or coping saw, file to shape, and buff to a high polish. On a jigsaw, blade speed should be reduced, as fast cutting generates enough heat to weld the cut together.

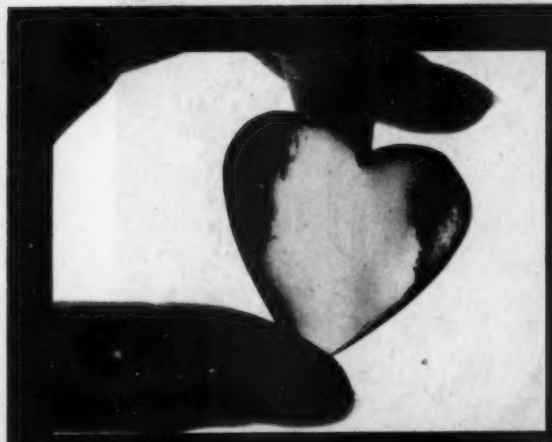
In making your selection of colors, go easy on the blue and green. These colors are much stronger than the others and are apt to overshadow the reds and yellows.



Refracted light adds to the beauty of plastic laminated with colored cement. Viewed edge on, the joint shows only as a dark line. But bevel the edges and the color appears.

Hacksaw the heart from the most colorful area of the plastic after scribing with a cardboard pattern. Rounded edges refract the light, making it colorful from any angle.

Turn a screw eye into the edge for attaching a chain or cord. First, drill a hole slightly smaller than the shank of the screw eye, which will then turn firmly into the plastic.



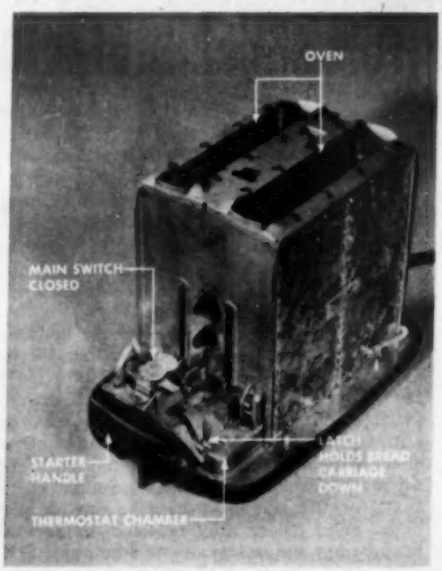
MECHANICS OF LIVING

How Your

PSM photos by Robert F. Smith

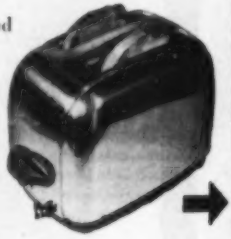
YOU push down the handle, wait . . . and the bread pops up all by itself, toasted to a turn. Ever stop to wonder how the toaster knows enough to brown your slice without burning it?

Automatic toasters are mostly of two types—both ingenious. One has a thermostat that cooks with the toast and switches off the current after the right amount of heat. The other kind is timed by clockwork, but uses a thermostat to speed up the machinery when full heat is reached. Here is what goes on inside both types, shown in Toastmaster toasters through the courtesy of A. Lockyer of Toaster Appliance Sales and Service Co., New York City.



Here is a thermostat-controlled toaster just after the handle has been pushed down, dropping the bread carriage into the oven. This has closed the main switch, and both the toasting elements and the auxiliary heating unit around the thermostat have begun to glow. A latch holds carriage down against tension of the "pop-up" spring.

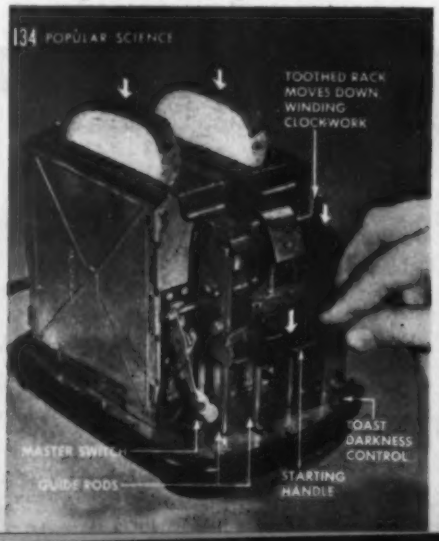
Thermostat-controlled automatic toaster.

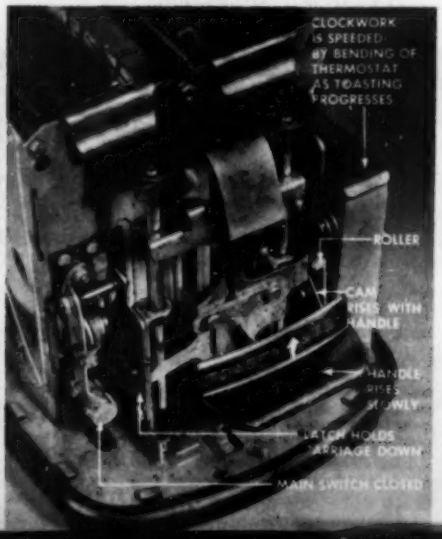


Thermostat- and clockwork-controlled toaster.

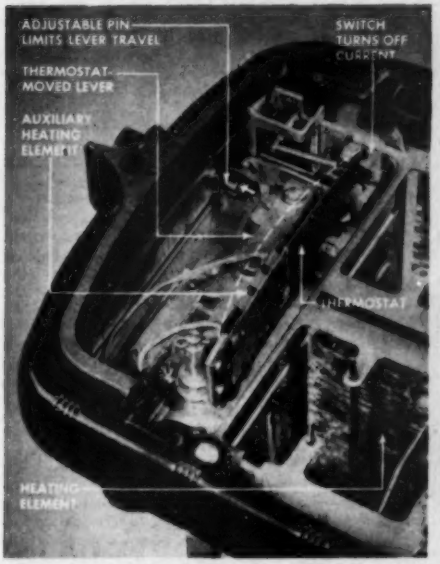
On this type, pushing down the big handle not only closes the switch but also winds up the clockwork timer and starts it ticking. Clockwork is in the box on far side, behind the hand. As in the thermostat type, the darkness control switch is at the lower right of the end of the toaster. The oven slides up and down on guide rods.

The latch grips the bread carriage in the bottom position, but the clockwork is slowly lifting the handle back to the top. With it a cam is rising toward the roller latch release that will pop up the toast. A thermostat under the toaster, shown in the next picture, is speeding up the clockwork as the toasting elements get hotter.

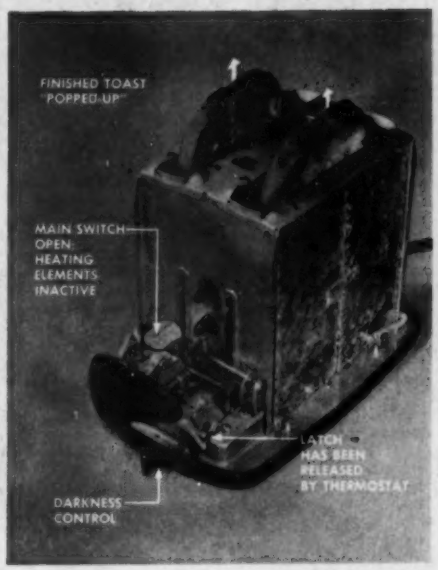




Automatic Toaster Works



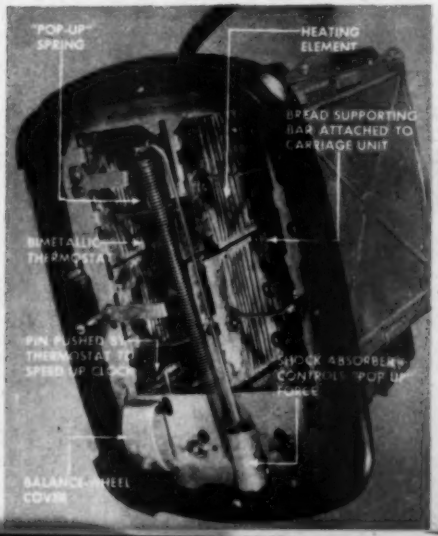
Removal of bottom plate of toaster shows thermostat bar wrapped in its own heating unit. As it grows hot, bar bends along dotted line, pushing lever beside it to left. When lever is stopped by pin, it halts movement of center of thermostat bar, but heat keeps bending bar, forcing its tip to the right. Tip pushes switch to shut off current.



As it cools, thermostat has straightened and released latch, allowing the carriage to pop up. The small control wheel on toaster end changes toasting time by pushing in or out the little pin that halts thermostat movement. Setting control at "light" pushes in pin so that it shortens time before thermostat tip bends, shutting off heat.

Removing plate from underside reveals bimetallic thermostat, close to the left of the long "pop-up" spring. As it heats, the thermostat pushes the pin, just to the left of its lower end, that increases the speed of the clockwork. This enables the clockwork timer to allow for the varying efficiency of the heating elements as they heat up.

At end of cycle, the clockwork allows the cam to push aside the roller, just above the handle in the center of the picture. This releases the latch holding the toast carriage, and the "pop-up" spring forces it up. At the same time the master switch, at lower left, opens, shutting off the current to the heating elements.



DONALD SYMINGTON

Real Planes Add Up to a Dream

DON'T let this odd contraption fool you. It's artist-flier John T. McCoy, Jr.'s idea of how a giant air liner the size of the B-36 might look. Despite its unconventional design, its features have all seen actual use in past or present aircraft.

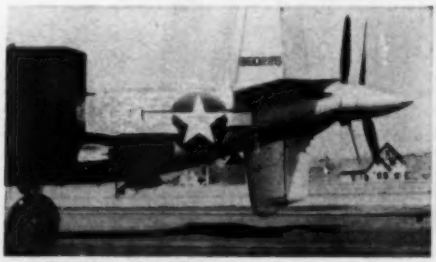
The huge plane's canard, or "tail first," design places the passengers ahead of engine noise and fire hazards, and provides a forward view unobstructed by a large wing. The bicycle landing gear saves weight, permits a thinner wing and helps eliminate gear failure, since the wheels retract into the fuselage and can be checked in flight.

Ex-Major McCoy, who has been flying airplanes since 1926 and drawing pictures of them even longer, has full confidence in the flying ability of his creation.

1 The retractable nose glass is borrowed from Republic's Rainbow. It uncovers conventional-type, flat windshield for undistorted vision during landings and take-offs.

2 Canard placement of wings harks back to the early efforts of the Wright brothers. It was used more recently on such experimental planes as the Curtiss XP-55 Ascender.

3 The bicycle landing gear, another old-timer, turns up again on the new Martin XB-48, as shown above. McCoy's use of it also includes the small outboard balance wheels.



4 Pusher-type tail props of the Langley are combined with wing-mounted jet engines as on this Douglas Mixmaster. The counter-rotating props reverse for braking and backing.

Think You Know

It takes 1,200 kinds for the many uses of nails;

By William P. Vogel, Jr.

PSM photos by W. W. Morris

1. Escutcheon Pin
2. Round Wire Spike
3. Metal-Lath Nail
4. Hoop Fastener
5. Barbed Dowel Pin
6. Roofing Nail
7. Nonleak Roofing Nail
8. Ribbon-Wire Staple
9. Fence Staple
10. Common Brad
11. Flooring Brad
12. Common Nail
13. Duplex-Head Nail
14. Round Dating Nail

TODAY the lowly nail is just as hard to come by as an automobile—for about the same reason. Demand far exceeds supply. Not only is building booming, but the nail is the end product of a long, complicated, steel making process. Nails must compete for raw materials with a host of other products. So even though steel men shipped 422,500 tons of nails last year, and are topping that record this year, you may still have to hunt quite a while for the right nail to mend your roof.

Colonial farmers hand-forged their nails during the long winters. Nails then were prized possessions, hoarded and straightened for re-use, often spent as money. Later, cut nails were made by machine, and since 1850 wire nails have been cold-drawn. Increasing mechanization has made nails more highly specialized, until today

The long and the short of the nail business are shown at left—a big boat spike with a tiny escutcheon pin on its head. Below are some representative in-between types.

Nails?

here's how they are made.

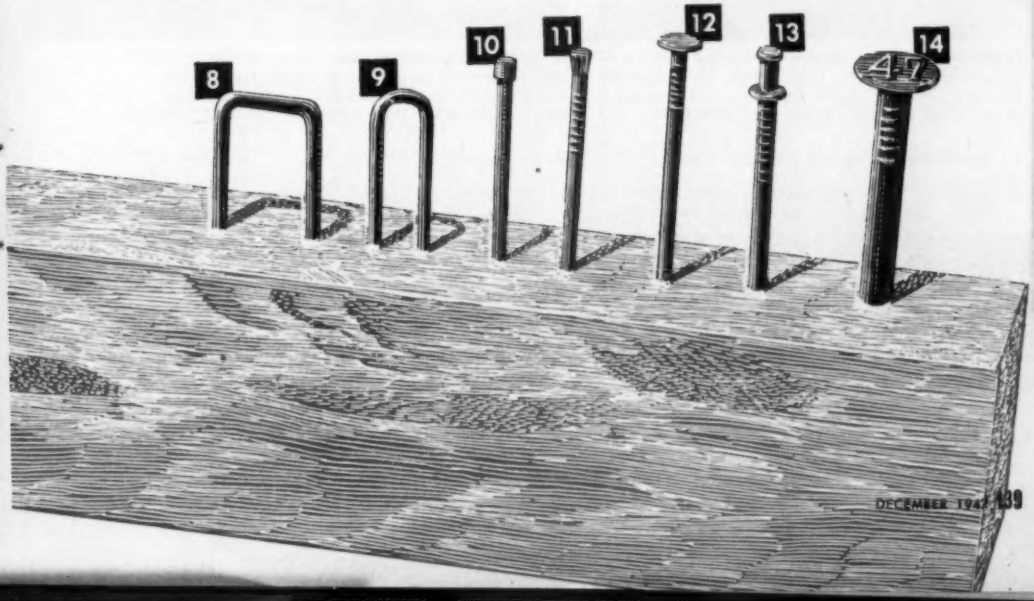
more than 1,200 species of nails are produced for as many different, distinct uses.

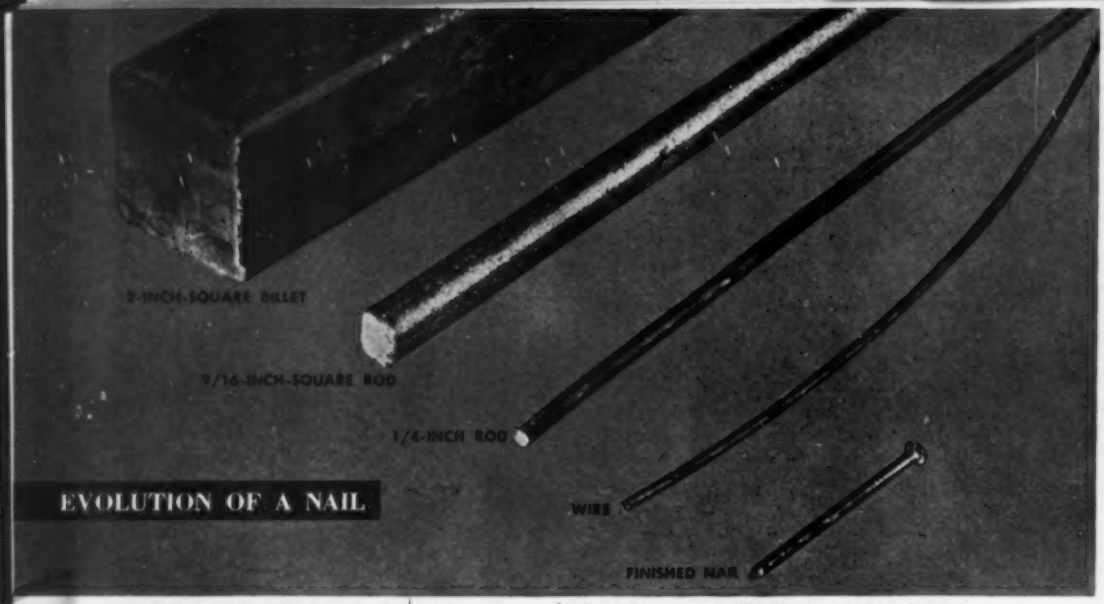
They range from 15-inch boat spikes, weighing 1 lb. 10 oz. each, to 3/16-inch escutcheon pins, fine as a needle, running 95,000 to the pound. In between lie all kinds of nails, including the common bright ones in sizes from 3- to 20-penny,* most widely used for housing and general purposes. There are barbed nails and cement-coated nails for jobs where extra holding power is required, as in making boxes and trunks. There are leakproof roofing nails, with a perfectly flat head surmounted by a tiny boss so that the hammer blow will not deform it. There are special precise brads with sharp diamond-shaped points for automatic flooring machines. Sterilized nails, with a characteristic blue color, are made for the benefit of lathers who put them in their mouths. Corrugated nails are popular where the hammer head might slip. There are special nails for gypsum board, egg crates, berry boxes; there are dating and marking nails, and even nails with two heads, one below the other, to make it easy to pull them out.

*One theory holds that in England nails were once sold by the penny; hence, a 10-penny nail was the size of which 100 cost 10 pence. An equally tenable idea is that 1,000 10-penny nails used to weigh 10 pounds, 1,000 16-penny nails, 16 pounds, etc. Whatever its origin, the penny system is now universal.

Here are steel ingots waiting to be made into rod, wire, and nails. Each 25- by 30-inch ingot is seven feet long, weighs six or seven tons.

Let's take just one group of nails—wire nails—and see how they are made. First, just any steel won't do. Nail steel must be worked both hot and cold. It can't be too soft or too hard. It must not oxidize too





EVOLUTION OF A NAIL

From billet to finished nail, the steel passes through the stages shown above. Previously, the big seven-ton ingot had a seven-minute workout in the blooming mill. There it first became an eight-inch-square bloom, 50 feet long; then a four-inch-square billet, 227 feet long.

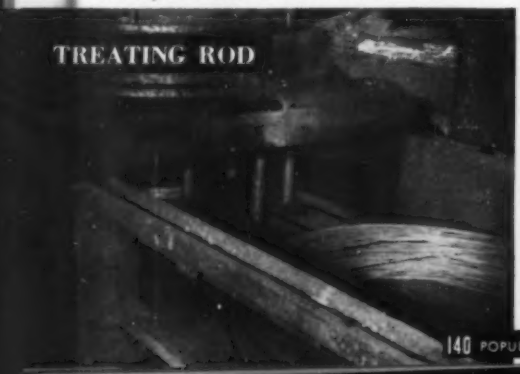
MAKING A BILLET

Eight-inch-square bloom becomes a four-inch-square billet in this mill. Here bloom passes through the fifth stand. In process it is twisted three times for good grain and structure.

DRAWING ROD

A 9/16-inch-square rod leaves the roughing mill. The rod, roughly diamond-shaped, is moving about 8⅝ feet a second as it passes through a flying shear that crops off the damaged ends.

In a reeking, noisy pit, steel rod is reeled after leaving finishing mill at 40 m.p.h. Over entrance of intensely hot pit, operator has scrawled: "Have you visited Hell's Kitchen?"



TREATING ROD

After cooling, the 400-lb. rod bundles are picked off onto a hook conveyer, inspected, and labeled to show hearth and heat numbers. Steel never loses its identity in entire process.

rapidly during milling. Most wire nails are made of good low-carbon steel, relatively free of phosphorus and sulphur.

In the huge Sparrows Point plant of the Bethlehem Steel Co., near Baltimore, the steel is made from Chilean ore, West Virginia coal, and Pennsylvania limestone. A "heat" of steel, generally 175 to 200 tons, is ladled into molds that form seven-ton ingots. As it rolls into the blooming mill, each ingot is almost white-hot, crusted heavily with scale that it has acquired enroute. The job of the mill operator is to reduce the ingot to a "bloom" 50 feet long and eight inches square. Because rolling deforms the ends of the bloom, it is cropped fore and aft by a powerful steam-driven, up-cut shear after it has been reduced.

The eight-by-eight bloom is run through the big rollers 15 or 20 times. Here it is squeezed through six stands of a smaller rolling mill that leaves the billet 227 feet long and squared off so that it will measure four inches on a side when cold. The four-by-four, still glowing, is reduced to a two-by-two and cut into 30-foot lengths for convenient handling and just the right size for working into rod.

In the rod and wire mill, the two-by-twos are heated to a uniform 2,000° in a continuous furnace. The billets enter the first of seven stands in the roughing mill, creeping at a foot a second, and come out of the last stand in the form of diamond-shaped steel rod, roughly 9/16 inch on a side, speeding about 20 miles per hour. Again, flattened ends are cropped off, and the rod goes through 10 stands of the finishing mill, roaring out at a 50-mile-an-hour clip, still white hot. Now and then a rod becomes a "cobble"—it misses its roll and runs wild. Usually, however, the rod coils up smoothly into 400-pound "bundles." After cooling, inspection, and labeling on a continuous hook conveyer, the bundles of rod are packed off to the cleaning house.

Cleaning is an important step. After the hot-drawing into rod, the steel is worked cold. Surface impurities and scale, being far harder than steel, won't draw into wire and play hob with the accurate tungsten-carbide dies. So the bundles are pickled in hot dilute sulphuric acid, then rinsed, limed, and baked.

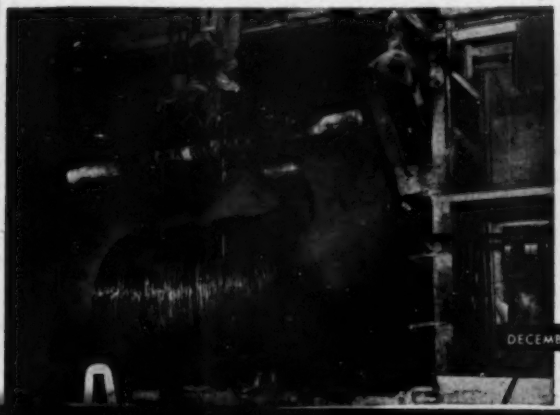
Modern high-speed wire-drawing machines are capable of turning out 20 tons of wire per shift. In three drafts, 10-gauge rod can be reduced to five-gauge wire, with a consequent increase in length. The collecting reel generally takes up finished wire at about 20 m.p.h.

Now a shiny, smooth wire, the steel is finally ready to be made into nails. The process is deafening and nerve-shattering, because nail-making is largely a matter of the terrific impact of steel against steel. In the nail mill, automatic machines turn out large sizes, such as 12-inch dock spikes, at the rate of 90 per minute; half-inch, 20-gauge nails emerge at 600 per minute.

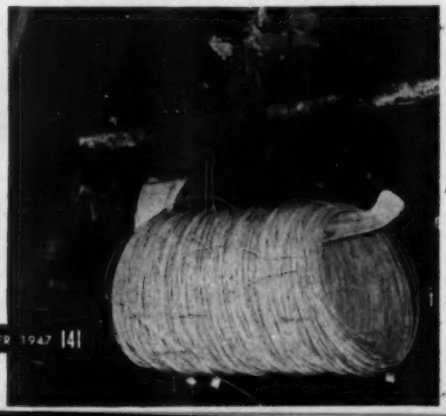
The wire is not fed into the nail machine continuously but in a series of jerks, ramming just enough wire into the gripper dies to make one nail. At the start of the cycle, enough wire projects beyond the grippers to form the head when a cam-driven hammer rises up and slams forward to upset it. By changing the hammer and the gripper dies, which act as the anvil, any type of head can be put on a nail: flat, oval, round, countersunk, corrugated, numbered, or bossed.

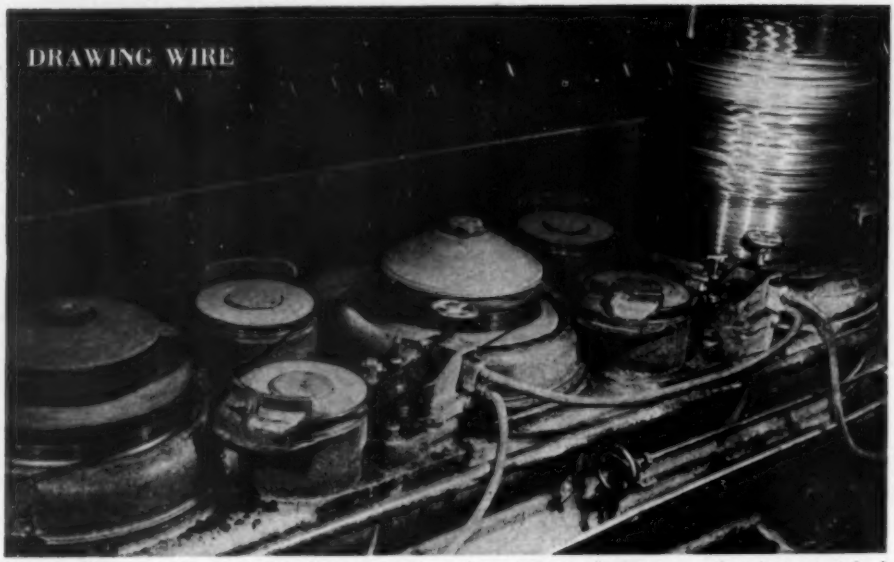
After the head has been formed, the gripper dies spring apart, the hammer cocks again, the headed wire moves forward and two cutters bite off the finished nail with

Rod bundles are next dipped in hot sulphuric acid to remove scale, then rinsed in water, silica-soda solution, and lime. Then they are baked for 20 minutes to harden the lime coating.



After removal from the oven the coils are greyish white. The lime coat forms a foundation for lubrication needed while rod is converted into wire by cold-drawing through dies.



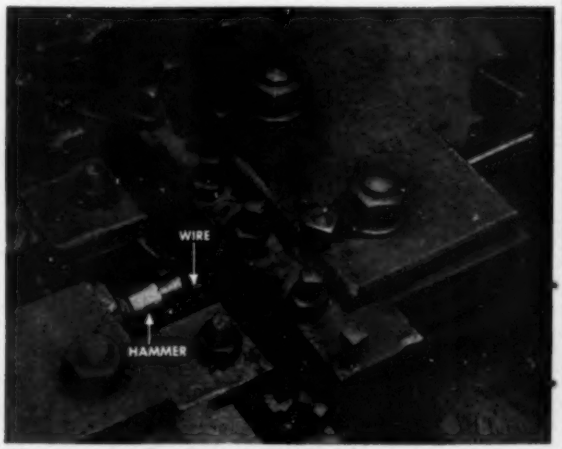


Here a 10-gauge wire is being drawn into 5-gauge. Three reels at left hold wire after it has passed through first draw. Second draw, in center, makes wire pass through opening smaller than its own diameter, so that it is stretched and made smaller. Three reels at right then take it up again and pass it to third draw, at far right, which brings it down to final size.

the proper point: diamond, needle, duck-bill, chisel, or flat. The marks on the nail below the head are made by the grippers. Steelmakers use various marks to brand their nails, and police cases have been solved by this method of identification.

As they stream out of the machines, nails are rough, whiskered, and burred, so they are tumbled in rotating drums. The nails, churned against the drum walls and each

The nail machine now goes into action. Here it is cutting 5-gauge wire into 8-penny nails. The nails are popping out of the machine at the rate of 325 a minute. Twelve-inch dock spikes can be turned out 90 a minute; half-inch, 20-gauge nails, 600 a minute.



Close-up of automatic nail machine shows the wire entering at right. At left center, just enough wire is sticking out of the gripper dies to form the head when struck by the hammer, at left. The cutter bars that make the nail point are now retracted.

other, are polished; sawdust picks up the oil, grease, and little slivers of waste steel. Poured out of the drum, the nails are shaken into the standard 100-lb. kegs you see in the hardware stores.

For many nails, however, tumbling is by no means the final operation. Cold-working makes the nail brittle; where a softer product is needed, as in clinching hinge nails, they are annealed in a furnace. Galvanized nails for outdoor work and roofing are tumbled in a bottom-heated drum containing flake zinc and a sal-ammoniac flux. When the zinc melts it flows evenly over the nails, coating them protectively, while the tumbling keeps the nails from sticking together. Cement-coated nails (which are *not* really cement-coated) are made by tumbling nails in a mixture of pitch and resins in solution. When the solvent evaporates, the coating becomes hard and smooth. The heat caused by driving a coated nail melts the mixture enough to "glue" the nail to the wood. Plated nails get that way in an electroplating bath, and painted nails are tumbled in a thin paint solution. Needle-pointed nails can never be tumbled; they have to be kept free from grease during manufacture and made so carefully that they have no whiskers when they emerge from the machines.

Short nails can be barbed with deep notches by special gripper dies; longer ones call for barbing rolls on the nail machine. Besides cement-coating, nails can be acid-etched or equipped with "fetter rings"—small circlets formed by gripper dies below the head.

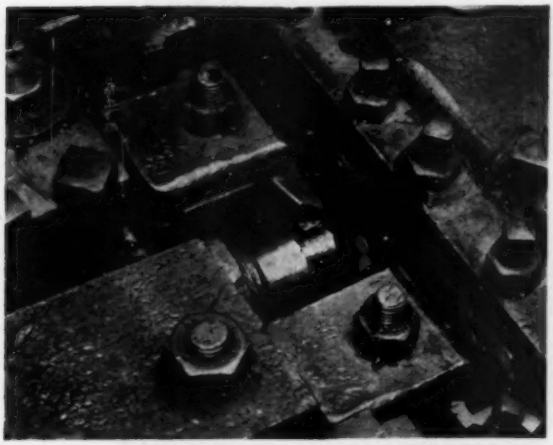
The best nail for the job is the type with the greatest holding power that causes the least distortion of the wood fibers. One of the reasons for the seemingly fantastic variety of nails is this necessity for maximum holding power in even more varied uses and materials. Where there's a will to join wood, leather, rubber, metal, or many other materials, there's usually a nail. END

Fiber Scales May Shrink Wool

WHY does wool shrink? One theory is that once the fibers draw together, as they do when wet, the scales on the fibers prevent their being pulled apart again.

X-Rays Developed Automatically

DOCTORS now can read X-rays an hour after they are taken. A completely automatic machine, developed during the war for processing industrial X-ray film, is being installed in hospitals that handle large quantities of X-ray work. Films ride a conveyer through developer, hypos, fix, wash and dryer at the rate of one per minute. In an emergency film can be read while still wet, after only nine minutes of processing.



Now the hammer has struck, flattening the projecting wire to form the nail head. In a moment, the wire will move to the left, ready to be cut off as a nail. The 8-penny nail, whose manufacture is shown here, is the most popular size of the most useful nail in the world.

The wire has now moved to the left, pushing the head out of sight, but revealing the gripper marks just below it. The cutter bars are about to come in and make a diamond point as they cut the nail off the wire. Next the nail will be tumbled to remove roughness and grease.

They Still Cut Ice the Old Way

HARVEST time is approaching on the Black River at Carthage, N. Y., where the New York Central Railroad still cuts an annual crop of natural ice. It will cool next summer's milk cars, passengers' drinking water, and be used in cabooses for the convenience of freight-train crews.

When the railroad started cutting ice on the river in 1901, it was a big operation. A decade ago 35,000 tons were cut every winter. But modern refrigeration methods, especially milk tank cars that work on the principle of a Thermos bottle, have cut into the operation. When one of two storage houses burned down, it wasn't rebuilt.

Even so, the New York Central is probably the biggest harvester of natural ice in the country nowadays. This winter the railroad expects to cut an estimated 12,000 tons of ice at Carthage and other cutting areas.

During severe winters, with three and four feet of snow on the ground and the temperature down to 20° below, 100 men and at least two teams of horses are needed to keep the work moving. Old-timers recall a record freeze when the ice was cut 32 inches thick, making individual cakes that weighed 736 pounds, or almost two-fifths of a ton for each chunk.

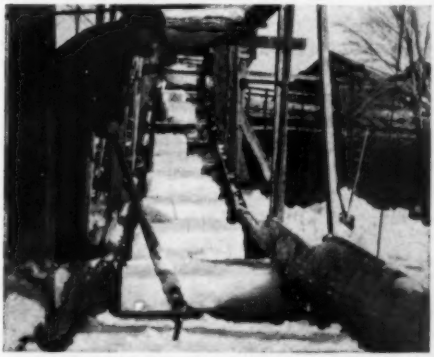
1. **Icehouse** has capacity of 7,000 tons. At far left is inclined conveyer that lifts the cakes to moving gallery. This runs outside the length of the building, carries the blocks to doors of storage rooms. Crew in foreground is splitting large floats into single cakes.

2. **Horse-drawn scrapers** are first on the job, cleaning snow off the ice. The sheet must be frozen to a thickness of at least 12 inches before the harvesting operation can begin.

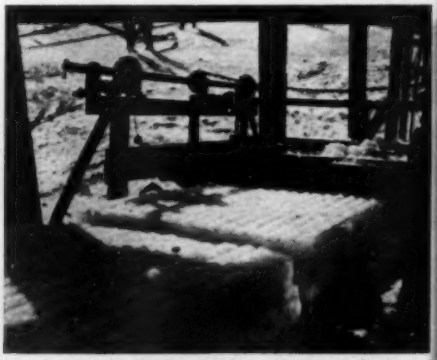
3. **To provide room to work,** first cakes are sawed by hand. End of the field is located upstream from storage house so that river current can help move ice down to conveyers.

4. **Gasoline-powered saws** take over. Working in teams of two, one laterally and the other longitudinally, they cut cakes measuring 32 by 22 inches. Blades bite 10 inches into the ice.

5. **Floats of five cakes** ride the channel. As these approach the conveyer, barring forks are used to split them through below the point reached by the saw, producing single cakes.



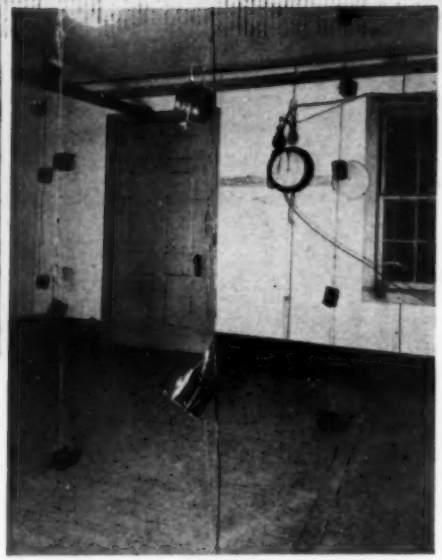
6. **Man with pike** urges the single cakes onto a conveyer that carries them up to a moving gallery that is adjusted upward as the ice storage house is filled higher and higher.



7. **As the individual** cakes move up, a planer shaves off slush and gives a rough surface to the ice for easier handling. Fourteen-inches of ice produce cakes weighing 322 pounds.

8. **As the cakes** move along the length of the icehouse, men with hooks stand at each of the eight entrances to the storage rooms and pull the cakes inward at the rate of one a minute.

9. **At 10 miles an hour,** the cakes slither down a chute to the packing crews. Keyman is the switcher, who must catch the quarter-ton blocks and guide them to where packers are working.



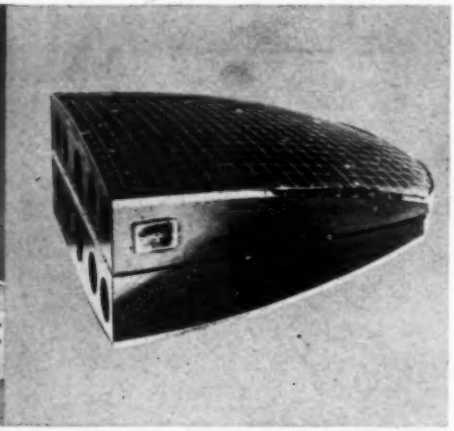
Closely spaced thermocouples, suspended from the ceiling throughout the house, register minute temperature variations at different levels.

House Tests Heat Flow

If anyone is cold in this house, it won't be for lack of heat—the house has nine complete heating systems, while scores of special heat-measuring gadgets take its temperature by the square foot.

Built by the National Bureau of Standards to test heat distribution and equipment, the bungalow was equipped with gas, oil, and electric heaters of various types, with meters to determine heat loss through walls, floors, and ceilings; thermocouples for temperature variations; and recording thermometers. The house itself, since enclosed in an insulated shell, follows plans widely used for low-cost homes, with the exception of wall insulation and weatherstripping.

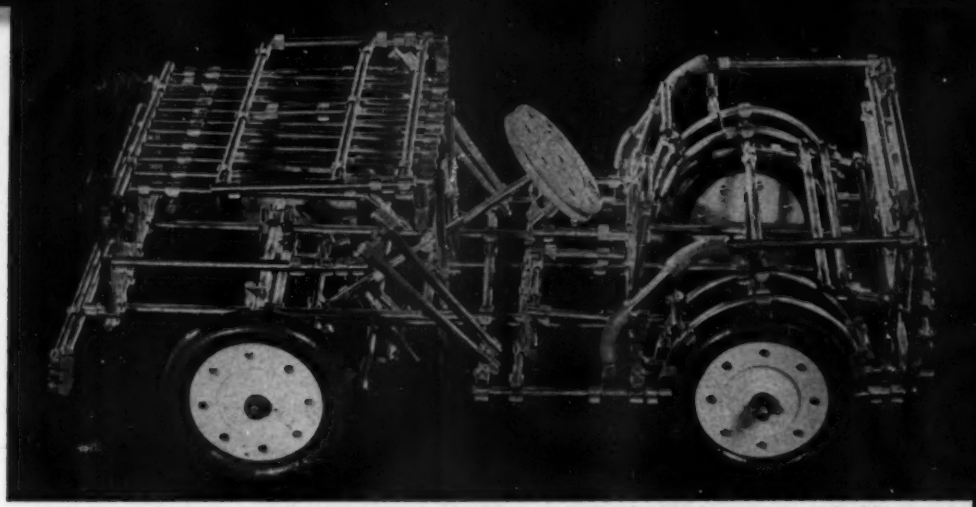
Chief discovery was that many heating systems produce wide temperature variations between foot and head levels, which, for health and comfort, should not exceed 15°, say engineers. So far, top honors have gone to a hot-water furnace, which squeezed the difference down to a mere 5°, and an electric heater and a gas heater, both equipped with blowers, which held the difference to 10°.



Sphere Maps End Errors

The problem of navigating a round world with a flat map may be solved by the use of curved maps that eliminate the distortions of flat projections—distortions that complicate long-range, high-speed flight planning.

Devised by Col. Carl J. Crane, U. S. Air Force, the slightly curved maps are actually sections of what, if assembled, would be a giant, 17-foot globe. Formed of translucent plastic, they can be fitted into the plotting table, at left above, and sections necessary for a particular flight can be carried in a plane. A special version of the air map is shown folded on the right.



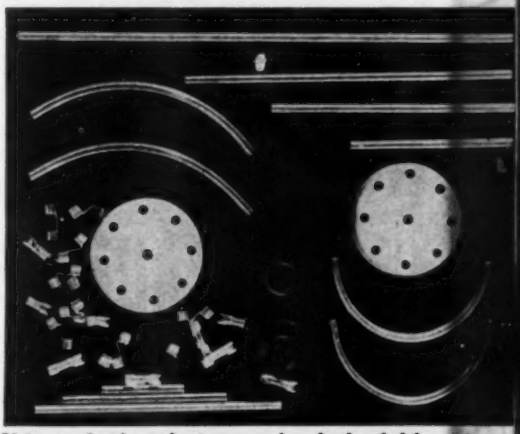
This toy jeep may look complicated, but new construction set's clips make it easy to build.

Clipping a Toy Together

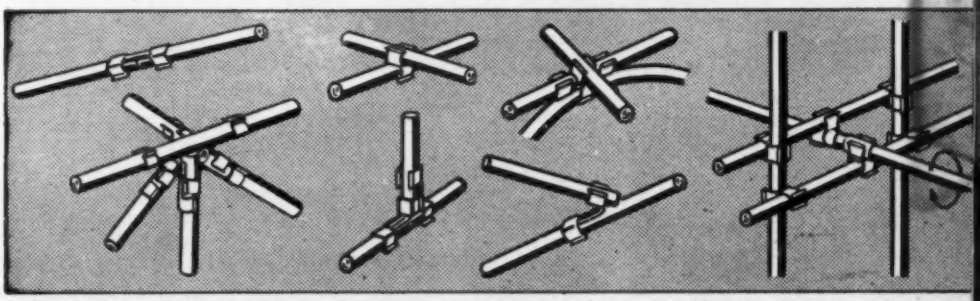
TAKE some straight and curved rods, snap them together with steel clips, add a few wooden wheels, and you have built the toy jeep shown above.

Secret of the new construction set, made by the Clip-Craft Corp., of New York City, is in the specially tempered steel clips that hold the aluminum parts tightly in place. Their edges are rounded and turned outward, so that a slight finger-tip pressure is all that is needed to insert the rods and arcs; dismantling is just as easy. The snap-action clips take the place of screws, nuts, and bolts, and make tools of any kind unnecessary for building even the most complicated structures.

Flat sheets of aluminum are furnished for covering surfaces of the models and for fashioning fins for planes. The wooden wheels can be used for gears and pulleys.



Using only these basic parts, hundreds of different toys can be clipped together. Arcs can be used to form complete circles.



These are a few of the joints that can be formed by combinations of the rods, arcs, and clips. A bearing added to a joint makes it a support for rotating or sliding shafts.

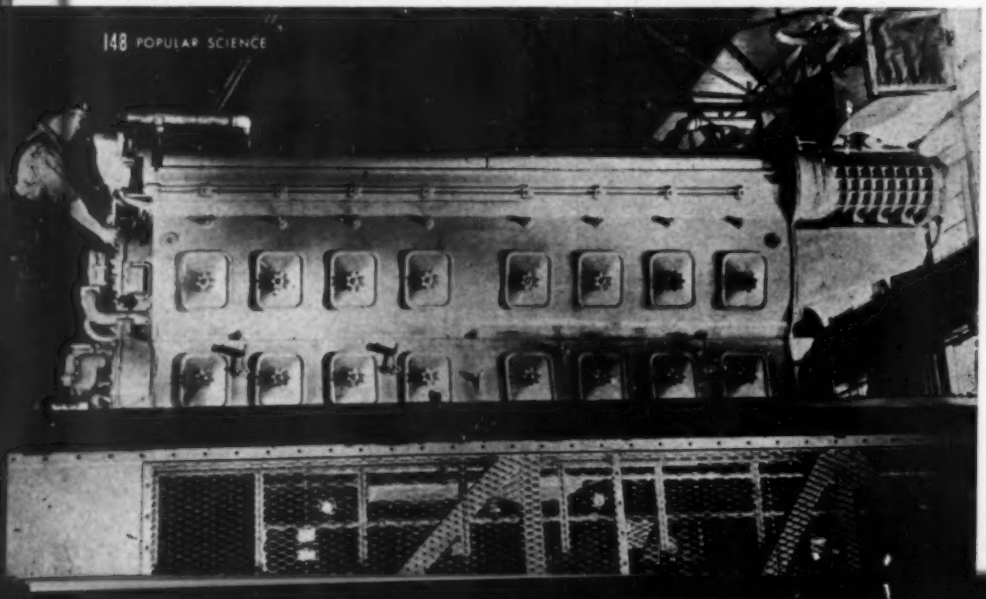
New 6,000-horsepower engine in foreground heads line-up of Diesels outside the new shops.

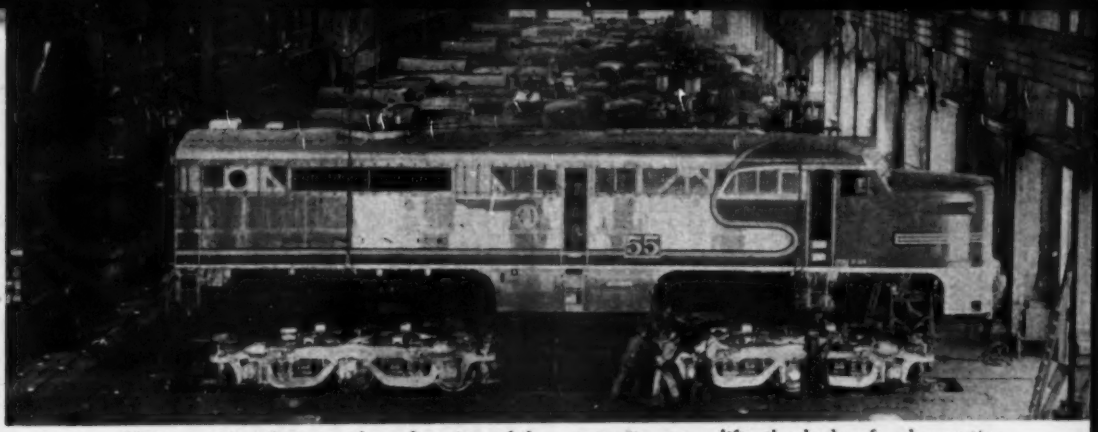
Shop in Desert Keeps Diesel Giants Rolling

BARSTOW, Calif., the gateway to Death Valley and once a desert junction for overland wagon trains, will soon be the center for servicing the Santa Fe Railway's fleet of huge passenger and freight Diesel-electric locomotives.

Although some of the overhauling and servicing shown on these pages is now done at other points, most of it will be transferred to Barstow as soon as new facilities are completed. Already the desert service center handles over half of the more than 700,000 Diesel horsepower the Santa Fe road has in operation.

Overhauled Diesel engine is lowered into a unit of the locomotive. When new shops are in full operation, they will handle every kind of work, stock 10,000 replacement items for all types of Diesels. At present 42 locomotives go through the desert center daily.



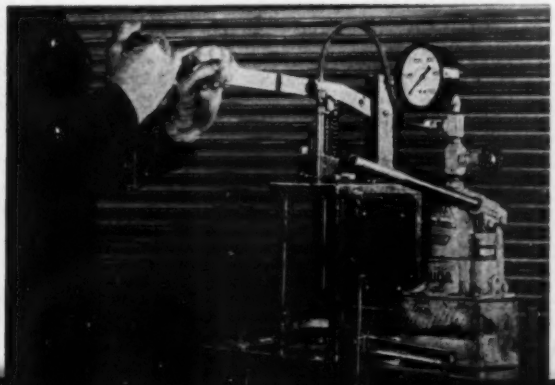


Major repair jobs on trucks and engines of the Diesel-electric units require the use of heavy-duty hoists and giant cranes. Here a 250-ton-capacity crane lifts the body of a locomotive as workers wheel the trucks away so that new ones can be brought up and bolted into place.

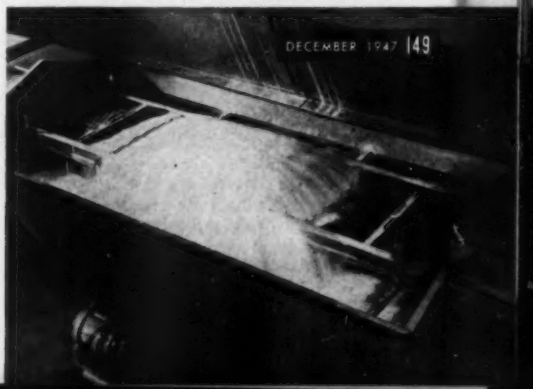
After overhaul in electrical shop, traction-motor armature is picked up by air hoist for return to frame in the foreground. Unless it balances within half an ounce, it is rejected.

Only four men are required to handle dollies onto which locomotive is lowered after trucks have been removed. Locomotive is then wheeled away to make room for another unit.

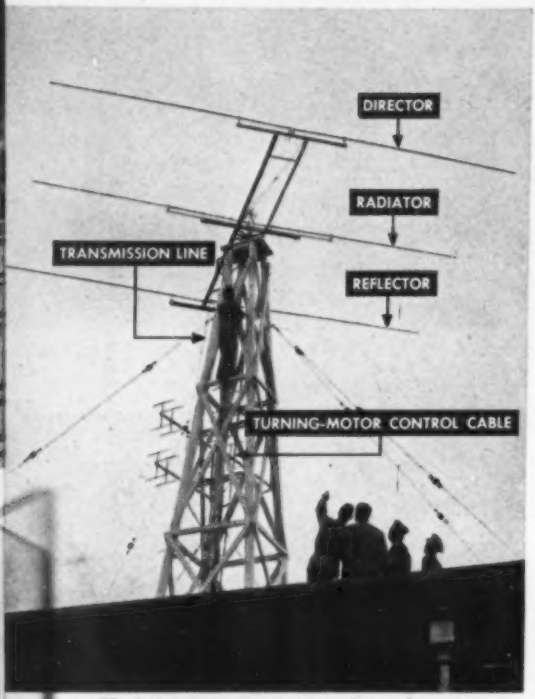
Fuel injector, heart of the Diesel engine, is shop-tested by applying pressure to the spring plunger, creating pump action. This shows whether orifices are open for proper functioning.



Fuel, lubricating oil, and even the air in a Diesel locomotive must be filtered to eliminate grit and dust. This geyser of cleaning solution is spraying one of the many filter units.



Antenna Gives Plane Radios Global Range



High-frequency rotating three-element array antenna, developed by the Air Force and Army Signal Corps, permits long-range communications between planes and command headquarters.

System requires no special equipment in plane. Using standard AN/ARC-8 liaison transmitter-receiver installed in all Air Force aircraft, operator has world-wide radio coverage.

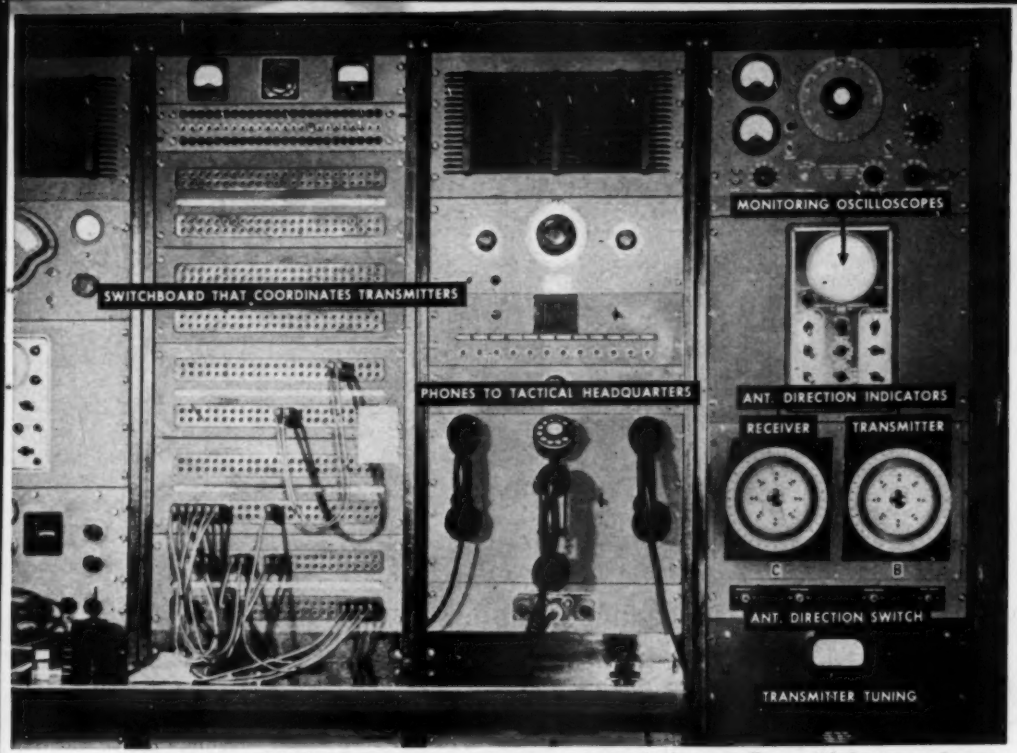
GLOBAL air power needs global radio communication. The United States Air Force has both. Recently a flight of B-29 Superfortresses left Tokyo bound for Washington on a one-stop flight. Forty minutes out, they turned on their radios and a few twists of the dials brought them into direct contact with headquarters-on-the-Potomac, some 6,000 miles away.

The planes didn't have any special equipment, used their standard liaison radio sets. Something new had been added in Washington, however—a "rotary beam parasitic array antenna" that literally tracks a plane along every mile of its flight any place in the world.

Known to radio hams for years, but used heretofore only for point-to-point transmission and receiving (PSM, Aug. '47, p. 92), this was the first use of the system for long-range air-ground radio communications.

The first transmission from the planes in flight gave map co-ordinates of their position, their indicated airspeed, altitude, and course. The radio operators in Washington then calculated the approximate position of the planes at the next scheduled transmission. The rotating beam was swung to bear on the expected position, and when the planes began sending, the antenna was tuned until the strongest possible signal was received.

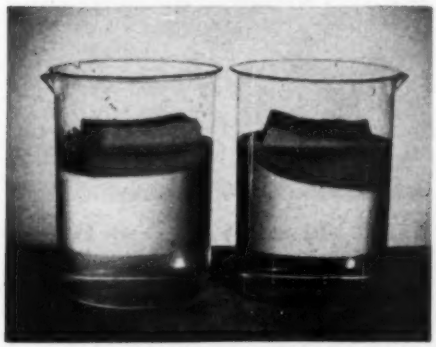
With emphasis on long range both in military and commercial planes, the advantage of instantaneous communication with a flight, no matter how distant, is obvious. Another advantage is the compactness of the new ground antenna unit, plus the push-button action that swings the tracking antenna completely around the compass in less than a minute.



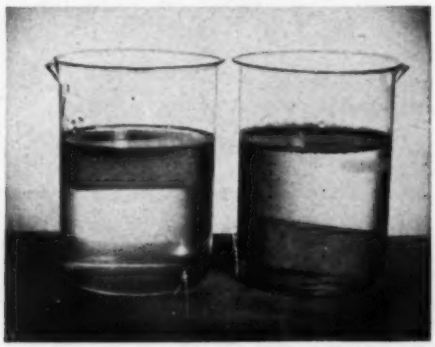
Brain center of the long-range communications setup is this control board. Center telephone panel connects directly with tactical headquarters, which normally would be some distance away. Receiving and transmitting antennas are also separated to avoid interference.

Wetter Water Helps Douse Fires

TO PUT out fires faster, fire departments now can get a chemical that, added to ordinary water, makes it "wetter." The chemical, produced by the American-La-France-Foamite Corp., of Elmira, N. Y., breaks the microscopic film normally surrounding water droplets. Mixed one part to 100 of water, the chemical, called Penetrate, gives the water a fast-spreading and penetrating quality that strikes at the heart of deep-seated, smoldering fires. It is no more harmful to materials than plain water.

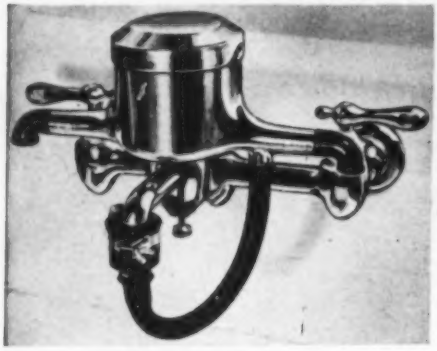


Artificial sponge, dropped in beaker containing ordinary water, got soaked but refused to sink all the way, as shown above.



Similar sponge, dropped in wetter water, sank to bottom in three minutes because the chemical had broken surface tension of the water.

AIDS TO MODERN LIVING

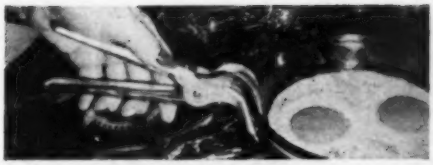


Washer Eliminates Dishpan. A new dishwasher introduced by Caldwell-Noel Corp., of Los Angeles, Calif., operates on any standard combination faucet. Soap is inserted and the water turned on to the desired temperature. Two streams of water emerge, one soapy for washing the dishes and the other clear for rinsing. Selling for about $7, the washer is available in polished aluminum or in enamel in pastel shades.

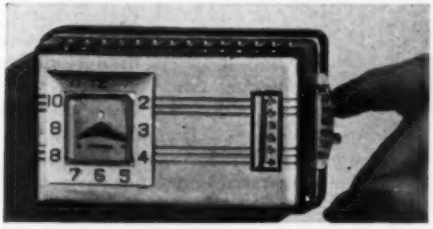
It Blows Hot or Cold. Containing a heating element, this new oscillating heater-fan may be used to circulate either warm air or cooling breezes through a room. It offers a choice of two speeds and two temperatures, can be set to oscillate or remain stationary, and may be tilted on its base by the turn of a knob. Priced at about $22, the appliance is a product of the Wittie Manufacturing & Sales Company, of Chicago.

Cigarettes Pop Out. Upward pressure on a thumb plate snaps open this cigarette case and lifts a carrier that forces the cigarettes up so they may be easily grasped. When pressure is removed, a spring returns the plate to its original position. The case, priced at $9, is a product of the Arthur C. Sogno Co., of New York.

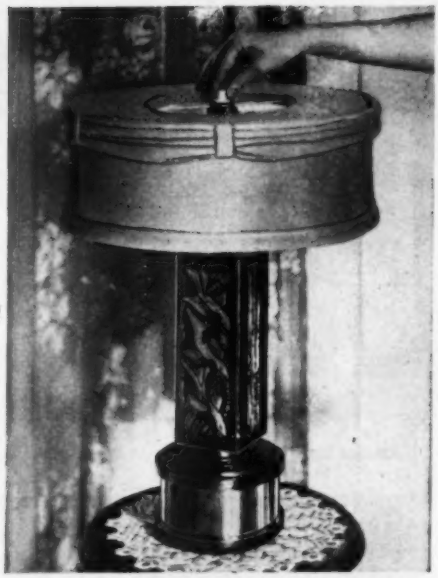
Light Shines When You Rise. If you get up at night, removal of your weight from the bed permits a spring-actuated switch to turn on this light. When you return to bed, it turns off again. The device, adjustable to the sleeper's weight, is made by the Rise N Shine Company, San Diego, Calif. It may be turned off during the day.



Device Grips Hot Pans. Operated like a pair of pliers, this stainless-steel kitchen tool is designed for easy handling of hot pans or plates. Priced at about $1, it is made by the Taylor Products Manufacturing Company, of Colorado Springs, Colo.



Thermostat Saves Heat. Fully automatic, a time-control thermostat announced by the Minneapolis-Honeywell Regulator Company, Minneapolis, Minn., includes a new electrical mechanism that prevents the heater from overshooting the daytime temperature limit during the morning. External controls permit easy setting.



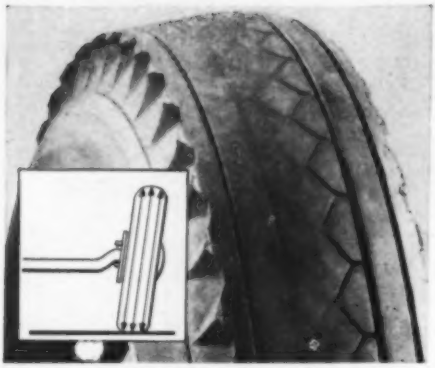
Lamp Has Switch on Top. A table lamp made by Homecraft Electronic Products, of Chicago, has the switch conveniently located on top of the shaft, eliminating the need of reaching under the shade. Using a circular 32-watt fluorescent tube for diffused light, the lamp has a brass base and wood shaft. Various shades are offered.

Toy Has Three-Way Action. This wooden rocker is designed to give a child an active ride. When the arms set the rockers in motion, the feet move up and down with the platform on which they rest, and the seat glides back and forth. The rocker is built by Hall Industries, Inc., of Chicago. It costs approximately $9.

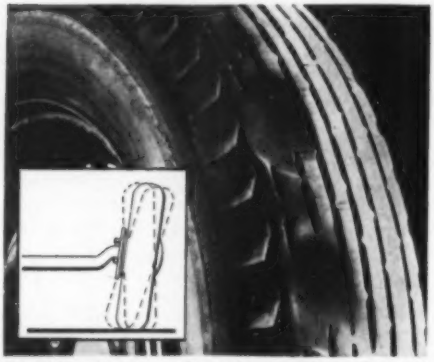
Stand Turns Yule Tree. Powered by a small AC motor, this stand not only supports a Christmas tree but turns it at the rate of three revolutions a minute. In addition, a special device supplies current to sets of tree bulbs while the tree is turning. The stand is produced by the General Die and Stamping Co., New York.

Most Flats Are Your Own Fault

By R. P. Stevenson



Excessive camber wears the tread away along the outer edge. When a tire shows wear like this, or as seen in the two photos below, an alignment job on your wheels is long overdue.

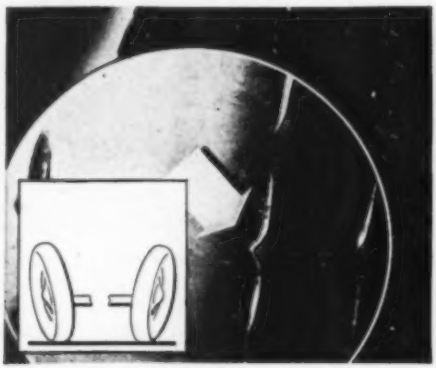


Wobbly wheels resulting from such mechanical defects as a bent axle or uneven caster soon make a tire look like this, flat spots being worn in the tread at irregular intervals.

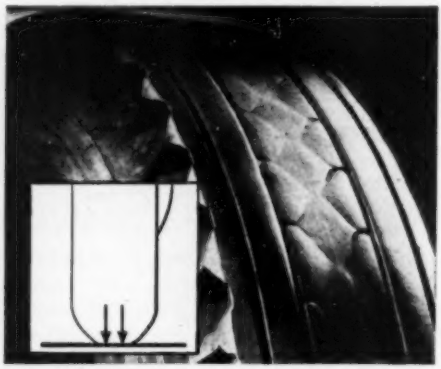
WHEN one of your tires goes suddenly flat along the highway, perhaps miles in the country on a dark and blustery night, it's a pretty safe bet that you might have detected the impending trouble and taken steps to prevent it. There's evidence to prove that some 90 percent of all such inconvenient tire failures can be avoided.

This doesn't mean you must scan every inch of the roadbed ahead for nails and tacks. Anyone is apt to puncture a tire now and then, and even the most careful driver occasionally bumps a rock or curb with sufficient force to break the fabric. Such damage almost invariably results in a flat. But —and this is a fact that drivers often fail to realize—complete failure may not come for days, and perhaps weeks. In the interval, there usually is ample opportunity to detect the symptoms of forthcoming failure and repair the tire before it hangs you up along the road.

Tires are built to give their maximum mileage under operating conditions over



A feather edge of rubber on front-tire treads is a sign of wrong toe-in or toe-out. A wheel ½" out of alignment drags the tire sideways about 67' every time the car travels a mile.



Overinflation wears the tread in the center, leaving the fringes in fairly good condition. Because of abnormal tension, such a tire also is more susceptible to cuts and tread breaks.

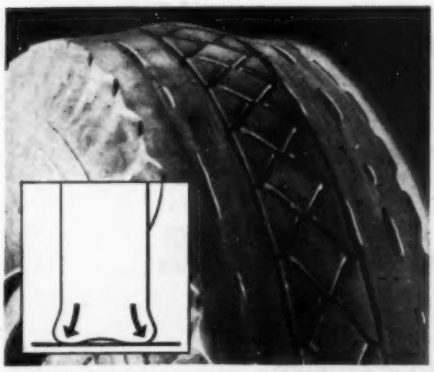
A streak of worn rubber behind one wheel of a stopping car means the brakes are unequalized.

which the individual driver has direct control. Basically, these are proper inflation, correct wheel alignment, proper adjustment and **efficient use of brakes,** and avoidance of damaging road obstacles. Carelessness about any of these points may quickly ruin a tire. Examples of such damage are illustrated on this and the preceding page.

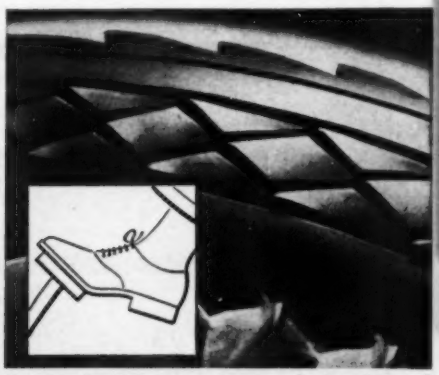
When a tire has been badly worn or damaged because of one of these reasons, it may of course go flat or blow out without warning. But suppose a comparatively new and apparently undamaged tire fails unexpectedly? What then?

In such cases, you may be sure that, barring a leaky valve or the slim chance of a manufacturing defect, the flat occurred because the tire, or maybe only the tube, was damaged in some way during operation—usually quite a while before the failure.

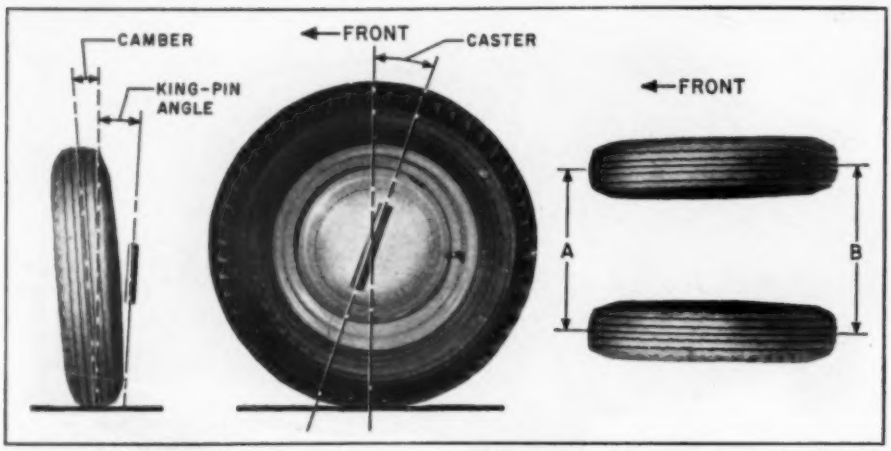
This fact may be turned to your ad-



Underinflation, especially if it is excessive, may have this unexpected result—heavy wear only on the shoulders. For the cost of underinflation, see the chart on the next page



Sudden braking causes one end of each tread button to wear more than the other, heaviest wear occurring on the end that first contacts the road. This is known as heel-and-toe wear.



Steering geometry involves proper relationship of camber, caster, king-pin angle, and toe-in (which requires that *A* be less than *B*.) If any element is off, undue tire wear will result.

vantage. It is the basis of a method of preventive maintenance developed by A. Schrader's Son, of Brooklyn, N. Y., a division of the Scovill Manufacturing Company, Inc. Called the "Comparative Air-Loss System," this method of preventing tire failure emphasizes that any excess loss of pressure, as shown by regular gauging, should be regarded as a warning that the tire has been damaged and will eventually go flat.

The system embraces four points:

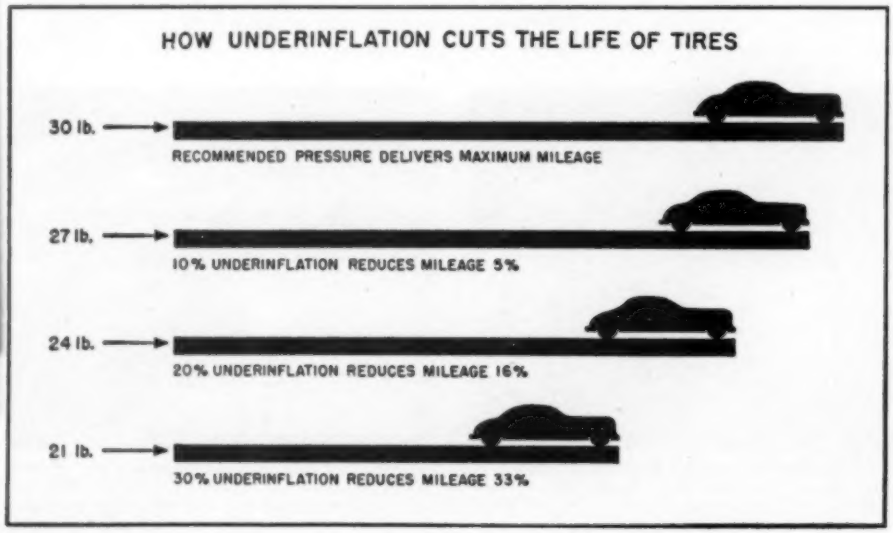
1. Gauging of tires when they are cool, once each week before adding air.

2. Recording and careful comparison of the pressures. If the pressure of one tire is 3 lb. below its running mate, there probably is a leak in the tube, and the cause should be immediately determined.

3. Keeping a valve cap firmly applied at all times, not only to prevent air loss in case the valve is faulty but also to restrict any source of leakage to the tube.

4. Removal of foreign objects from the tire surface when the car is lubricated.

Originated during the war as a tire conservation measure, the system was featured



Warning of a flat tire is contained in this record. The excess pressure loss in the right front tire indicates a slow leak. If a flat is to be avoided, this tire should be checked at once.

in a bulletin distributed to branches of the armed forces and to bus and truck fleet operators. That it produces results is shown by the experience of one company operating a fleet of trucks. Before adopting the system, the company had an average of three flats a day. Subsequently, the same trucks ran for six months and one day, a total of 236,000 miles, before the first roadside flat occurred.

The system can be applied to passenger cars with equal results, and a test on a 1946 model, reported by the Schrader company, shows why. At the beginning of the test, the car still had the original tires and tubes and already had run 11,284 miles. While cool, the tires were inflated to 28 lb. Then, 20 nails were deliberately driven into the four tires, and the car was started out on a test run at above average speed. At the end of five days, the tires were reinflated to 28 lb., after first being gauged. At that time, despite the presence of the 20 nails, the greatest air loss for any tire was 10 lb. On each day thereafter, the tires were brought back to 28 lb.

Finally, after the car had been driven 1,051 miles, one tire dropped from 28 to 10 lb. pressure, and then went completely flat after the car had been standing about 10 minutes. The second gave out at the end of 11 days and the third after 16. It was not until the 18th day, after 1,844 miles of driving, that the fourth suddenly went flat on the road. If any one of these tires had been punctured accidentally, the excessive amount of air required to keep it properly inflated should have been taken as a warning.

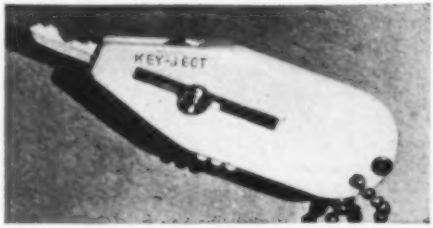
One important point to remember in applying the air-loss system is that tires should be gauged and inflated only while they are cool; that is, at atmospheric temperature. During operation, normal flexing of a tire generates heat, and the heat causes the pressure to increase, possibly several pounds. If a tire is inflated—or deflated—at this time to what is assumed to be correct pressure, it will be underinflated when cool.

To make the air-loss system work to your best advantage, it is therefore advisable to have your own hand gauge and use it before moving the car from the garage. Then, if no tire shows an excessive loss, you can drive to a filling station and bring them up as needed. But if one does show a sudden drop, better investigate at once. END

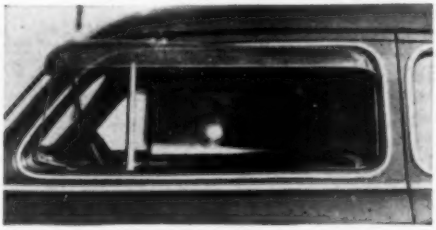
Gauge your tires weekly, taking the reading after the car has stood at least two hours.

Arm Rest Is Removable. Although designed particularly to support the driver's right arm on long trips, this arm rest also may be used by a passenger in either the front or rear seat. If turned sideways, the foam-rubber cushion also doubles as a high chair for a youngster. A broad metal base keeps the rest upright while in use. Manufactured by the Perlin Perfect Products Company, of Chicago, the rest sells for about $3.50. It stows away compactly when not in use.

Hand Throttle Rests Foot. Pivoted under the steering column so it may be swung right or left for use by either hand, this hand throttle is connected to the carburetor by a flexible wire and may be used interchangeably with the foot accelerator. The throttle is placed so that it does not interfere with operation of the gear shift, gas being fed by drawing the lever gently upward toward the steering wheel. Made by Trans Continental Industries, Inc., of St. Louis, Mo., it sells for about $6.



Key Springs from Lock. Designed to prevent drivers from leaving the ignition key in the lock, a key case manufactured by Robert Hetherington & Son, Inc., of Sharon Hill, Pa., contains a spring that causes the key and case to spring out into the hand as soon as the ignition is turned off. It retails for about 40 cents.

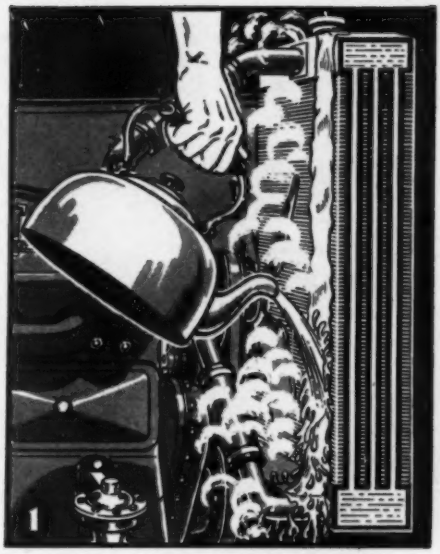


Awnings Are Transparent. Made of transparent plastic in blue or smoky green, these car-door awnings provide shade without materially reducing the visibility. In addition, they afford protection from rain and snow. Introduced by the Toadroy Manufacturing Co., of Wellington, Kan., they sell at $13.50 to $19 a pair.

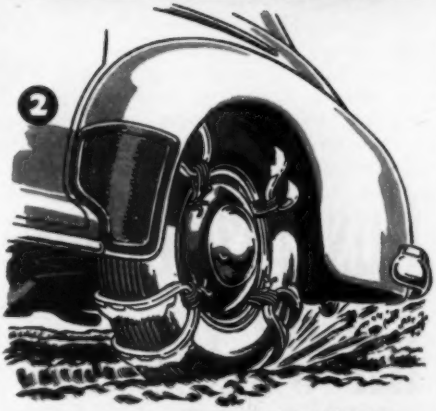
Caution Sign Reflects Light. A caution sign introduced by Strayline Products Co., of Dobbs Ferry, N. Y., measures 9″ by 24″ and stands 24″ high, but it may be collapsed into a compact bundle for storage. Made of aluminum, the sign has reflecting letters that are clearly visible up to 250′ at night. It sells for about $3.

AUTO HINTS

1. How to Thaw a Radiator. Hot water poured against a frozen radiator in a narrow path from top to bottom directly over the lower hose connection will thaw a strip 2″ or 3″ wide and restore circulation. When the motor is started, the hot water inside the thawed tubes will soon free the entire radiator. A length of hose slipped over the kettle spout will enable you to reach inaccessible spots.—E. R. WALSHAW.



2. Belts Serve as Chains. Heavy V-belts wired to a wheel as illustrated work well as emergency chains. I always carry a few for that purpose.—GEORGE E. TOMLIN.



3. Inexpensive Flares. Waxed milk containers may be used effectively as flares to warn oncoming traffic when you must make car repairs along a highway at night. Ignited at the top with a match, they burn like torches for five or six minutes. A small stone dropped in the bottom will keep the wind from tipping them.—N. W. GOODWIN.

4. Turner Cleans Off Snow. An ordinary pancake turner carried among your tools will prove a convenience when next you return to your parked car and find the windshield and rear window coated with clinging snow. It may also be used to chip ice off the windshield.—W. E. PRITCHARD.

Drawings by STEWART ROUSE

"I spotted a sign saying there was a garage and repair shop 15 miles further on."

Gus Prescribes an Oil Change

By Martin Bunn

JOE CLARK'S voice over the wire was waspish. "That highbinder charged me twice what the job was worth to put in those new rods—and when he got 'em in the engine wouldn't even turn over. I told him that I wouldn't pay him for work that hadn't done any good, and he said he'd hold the car until I did pay him. Then I told him—"

The thought of Joe Clark on the customer's end of an argument over a repair-job bill made Gus Wilson grin. "Never mind what you told him. What did you *do*?"

Joe's voice went up three notes. "Do?" he yelled. "What could I do? I had to pay him, of course. But I wouldn't let him touch the car again. A fellow helped me push it out of his shop; now it's standing in the street. The engine won't start, and the next garage is 10 miles away. They'd charge plenty for a tow and probably won't be any better than this nitwit! You or Stan'll have to come with the wrecker and tow me home."

"That's quite an order," Gus hedged. "Where did you say you are?"

Joe named, in highly uncomplimentary terms, a very small town.

"That's well over a hundred miles from here," said his partner after a brief tussle with a road map. "It's almost closing time now, and it'll take most of the night to bring you in . . . Well—O. K. I'll send Stan. By the way, Joe, is there a college handy to that burg you're in?"

"How'd I know?" Joe yelled. "And what difference does it make?"

"I was just thinking that while you're waiting for Stan it would be a good idea to take a quickie course in mechanics!"

The receiver was slammed on its hook

at the other end of the line. Gus grinned. Then he went serious. He was a prey to the vague uneasiness that assails every conscientious mechanic when he hears that a car he has worked on has conked out. "I checked Joe's bus before he started on this trip to Pittsburgh," he thought, "and it was in good shape—considering it's a '39 and has clocked over a hundred thousand miles. Well—we'll see."

STAN and Joe reached home sometime in the course of the night. When Gus got down to the Model Garage next morning he found his partner's car in the shop and its owner, still simmering, waiting for him. "You're a swell advertisement for our business," Gus grinned. "What happened?"

"Nothing happened until I'd got three-quarters of the way home," Joe growled. "I was driving along at about forty with the car running swell—just like it had been running ever since I left here—all of a sudden there was the darndest clatter you ever heard. The sound seemed to come from the crankcase. I figured it was a burned-out connecting-rod bearing that was just about to let go. This happened 'way out in the sticks, but I spotted a sign saying there was a garage and repair shop 15 miles further on. I decided to take a chance that the bearing would hold out until I got there. The clatter didn't let up, but it didn't get much louder, and I made it.

"The fellow who ran the garage could probably find a flat tire if you pointed it out to him, so to save time I said I thought it was a burned-out rod bearing. After he fooled around for 15 minutes he reckoned I was right. I let him go ahead and fix it, and went down the main drag to get something to eat. When I got back he had the crankcase all unbuttoned. He said that all six rods were bad and I'd have to have new ones. Frankly, they didn't look too bad to me, but I was still hoping he knew what it was all about, so I asked what the job would cost. He quoted more than twice what we would have charged for it, and we had an argument. But in the end I told him to go ahead.

"He sent his grease monkey 20 miles to get the rods, and when he finally got started I could see he was strictly a left-handed mechanic. At last—late in the afternoon—he got the rods installed and the engine back together. Everything was fine—except that she wouldn't run! That reformed blacksmith stood there scratching his head. He suggested one thing after another that might be the matter, but I could see he was up a tree. I told him that if he found out what was wrong and fixed it I'd pay him for the job, but I wasn't going to pay for putting in six new rods that weren't needed. We had another argument. He threatened to phone the constable and have my bus held, so in the end I had to come across. By that time I was so sore I wouldn't let him try anything else. I found a fellow to help me roll the car out into the street, and then I called you . . . What do you think can be the matter with the old bus?"

"Soon find out," Gus grunted.

HE RAISED the hood, and went over the engine. While he was doing it Stan came in yawning widely. Gus told him to touch the starter. "No use, boss," Stan protested, but he did as he was told.

The starter ground over with no response from the engine, not even a cough. Deftly Gus checked the fuel and ignition systems; both were operating properly. He thought for a moment and then, on an impulse, removed the valve cover plate and touched the starter solenoid. As the engine was cranked over, Gus was startled to find that the valves remained motionless. Frowning as he worked, he took off the housing on the camshaft timing gear.

"Here's the trouble!" he exclaimed. "Look—five teeth have been stripped off this timing gear. I wonder what caused that? It's made of laminated plastic, so it'd probably give before the steel crankshaft gear, but—hey! The jet that's supposed to spray oil in here is plugged solid!"

He cleared the oil passage with a piece of wire, and rolled what he got out of it between his thumb and forefinger. "Solid sludge," was his verdict. "It stopped lubrication of the gears; heat and friction did the rest. I wonder—"

He got an old drinking glass from his bench, washed it, drained a little oil from the crankcase into it, and held it up to the light. "Your oil is foul with sludge and muck," he said. "No wonder you had trouble—the surprising thing is that you didn't have more of it." He looked hard at his partner. "I told you to fill up with fresh oil before you started. Did you forget to do it?"

"Of course I didn't forget to do it!" Joe snapped. "What do you think I am—a

dope? Why, I even used heavy-duty oil—that new premium stuff we got in just before I left. The oil-company salesman had been telling me how it keeps sludge and such stuff suspended instead of letting it settle in the oil pan, and I figured that using it on my trip would be a swell way to clean out my engine. When I got to Pittsburgh I checked the oil level. The dip stick was as shiny as new—the oil had cleaned all that sticky brown stuff off it, so I knew it was doing the job the salesman said it would."

Gus stared at his partner. "And you didn't change the oil?"

Joe looked surprised. "No. Why should I? I'd gone under 1,000 miles and there was plenty in the crankcase. What's all this about, Gus? Aren't the new premium oils any good?"

"Sure, they're good," Gus assured him. "So is dynamite or TNT or atomic power—*if* you know how to use 'em. But premium, or heavy-duty, or detergent oil—they all mean pretty much the same thing—can cause a lot of trouble if you don't use it right. So much trouble in fact that some of the oil companies aren't recommending it for passenger cars."

Joe looked horrified. "That's bad!" he said in a worried voice. "I haven't sold any of it yet, but I've talked it up to several customers. We'll be behind the eight ball if any of them take my word for it and get in trouble, the way I did."

"That's all right," Gus reassured him. "You can go right ahead recommending it for cleaning out engines, and for all-the-time use by drivers who make long trips at high speed—so long as you make darn sure that the people you sell it to know how to use it."

JOE pointed to the broken timing gear. "That doesn't look as if I know how to use it. If it's that tricky—"

"There's nothing tricky about it," Gus interrupted, "if you stop to think that a detergent oil is just what it claims to be—a purging oil. While it lubricates, it cleans off the sludge and other muck—the waste products of combustion—that accumulate on the innards of an automobile engine. Usually there is a dispersant in these oils, a chemical that is added to keep dirt and sludge suspended, instead of allowing them to settle into the oil pan. What you've got to remember is that the detergent cleans the accumulated sludge *off* the engine parts but not *out* of the engine until it is drained off with the oil.

"Your car has been driven over a hundred thousand miles, mostly short runs, without ever having its oil pan down, so its engine must be pretty dirty. I've been meaning to clean it up for you, but since we've always babied the car and it continued to run well, I never got around to it. You put in detergent oil and then drove from here to Pittsburgh and three-quarters of the way back—say 750 miles. That long run gave the purging oil a good chance to do its job, and it did it. The trouble was that it cleaned so much sludge out of the engine and into the oil that the oil passages couldn't digest it. They clogged up. The jet that sprays oil between the crankshaft drive gear and the camshaft gear was plugged solid with hard, high-temperature sludge. If the resulting breaking of the timing gear hadn't laid you out on the road, you probably would have burned out a bearing—the bearing lubricating tubes are nearly filled up."

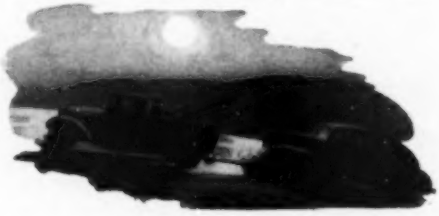
"And still," Joe growled, "you say there's nothing tricky about detergent oil!"

"There isn't," Gus said. "Not if you change it before the sludge it has cleaned off the engine parts has a chance to do any damage. For an engine that's just average dirty, the oil should be drained, and the crankcase flushed, after about 300 miles, and again after another 500 miles. But for an engine that's really dirty, the first change should be made after only about 100 miles. You can't do any harm by changing the oil too soon—but you can do a lot of harm by not changing it soon enough."

"You've got something there," Joe admitted. "Now if you can get my bus rolling, maybe I'll take a little drive."

"What for?" Gus asked apprehensively. "You aren't figuring on trying to collect the dough you spent for the con-rod job?"

"Naw." The co-owner of the model garage smiled sheepishly. "We got a college right here in town, and I'm thinking it's about time I took that quickie course in mechanics you've been talking about." END



Mechanics and Handicraft

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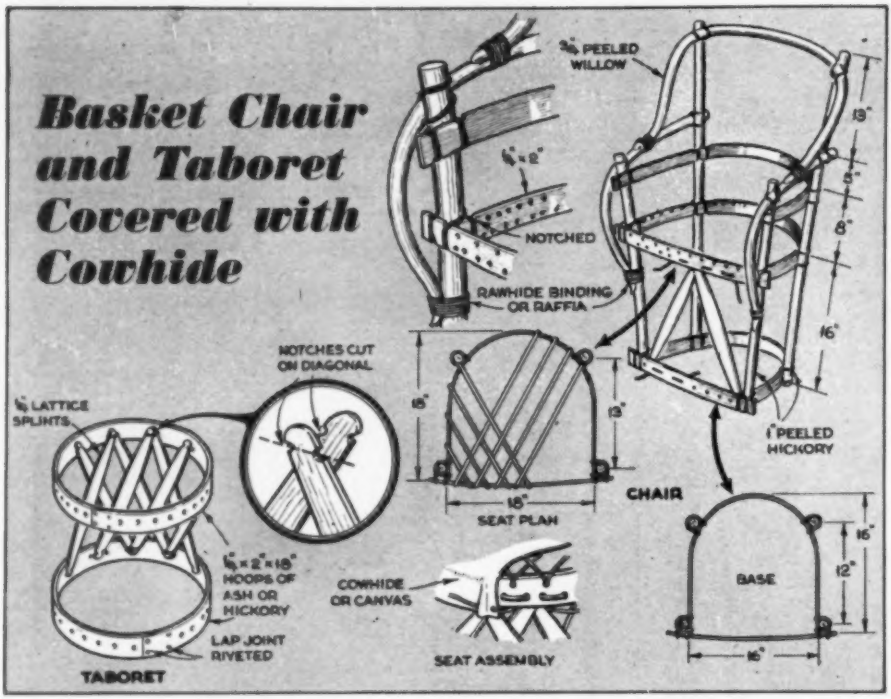
Child's Wardrobe PAGE 170

Glass-Topped Iron Tables PAGE 186

How to Silverplate Wood PAGE 210

Chemistry Spins a Yarn PAGE 214

Basket Chair and Taboret Covered with Cowhide



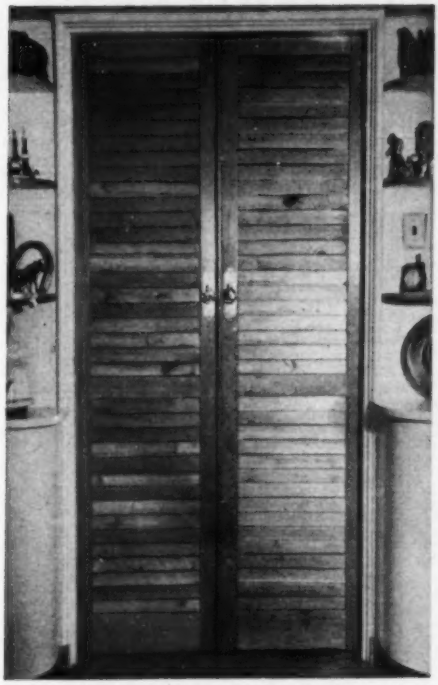
MEXICAN craftsmen introduced this patio furniture to the Southwest. Working with primitive tools and materials, they have managed to fashion such comfortable and eye-appealing pieces that the supply of imported chairs and taborets like those illustrated has fallen hopelessly behind the demand. If you have a spot in your porch or garden that calls for this rustic furniture, you'll find that the quickest way to fill the vacancy is to build it yourself.

Date-palm fronds are used in this Mexican original, but ¼" splints may be easier to obtain.

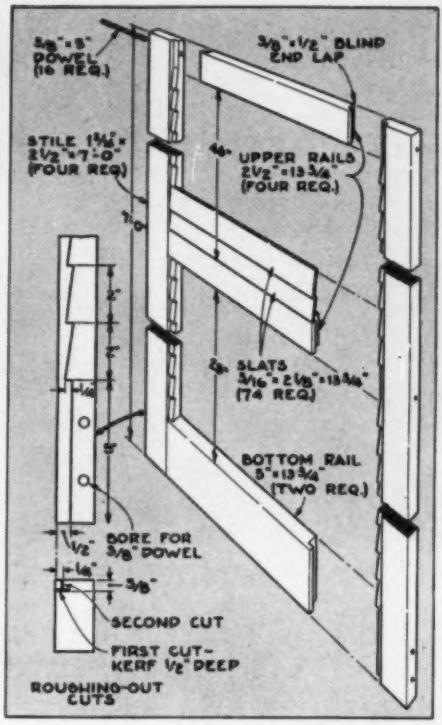
The drawing shows a simplified adaptation of the original; it can be made with jackknife, saw, and hand drill. Willow withes or other flexible branches that may be picked up in the woods are ideal for the frame. Hickory or ash should be used for the seat and base hoops, and ¼" lattice splints for the diagonals that join them. Rawhide or raffia, and cowhide or canvas, in any combination, serve for the lacing and seat and back.

Soak or steam the ash or hickory and bend it around a rough form to make the three semicircular hoops needed for the chair. Bind them to the four legs with rawhide or raffia set in casein glue or shellac. The curved top frame and arms are installed next, and the diagonal slats are bound inside the hoops as shown. Rawhide strips are crisscrossed over the seat to support the cowhide or canvas cover, which is then fitted and laced in place. Seat and back are cut separately, and each piece is laced tightly in its frame.—HI SIBLEY.

Swinging Doors Close Off Kitchen



Fit the doors with brass hardware. Hang them to swing either one or both ways as desired.



BESIDES being a convenience, swinging doors of the ship's-cabin type bring a note of distinction to a doorway between the kitchen and dining room. The dimensions and requirements given in the above drawing are for two doors to suit a 3′ by 7′ doorway.

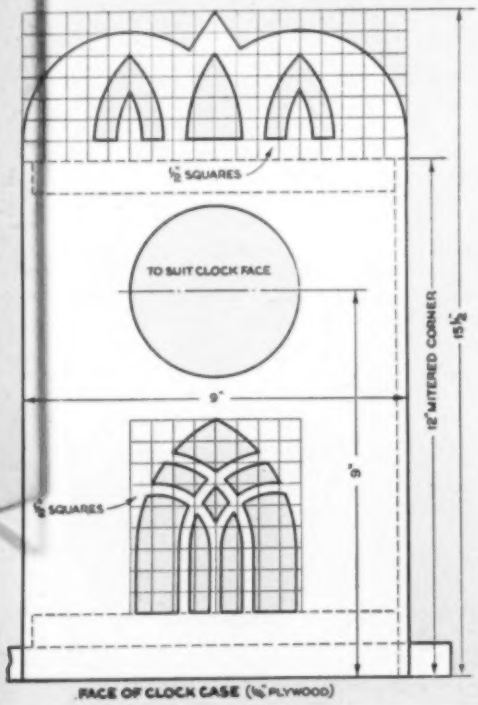
Stiles and rails may be made from 1½″ door stock (it measures 1 5/16″ net), cut to size, and joined by blind end laps pinned with ⅜″ by 5″ dowels.

Notches may be cut in the stiles for the slats by first making a saw kerf ½″ deep ⅜″ from the edge and then sawing away a ¼″ section of this cut. At the points where the three rails join the stile, chisel out to the bottom of the first saw cut. Then mark off the notches 1⅞″ apart to allow the slats to overlap slightly, and chisel out the notches. Alternatively, notches might be made by cutting wedges and gluing them into a rabbet.—Edward R. Lucas.

Chisel out each notch after cutting kerfs as shown in the drawing. Space them 1⅞″ apart.

Overlap the slats slightly and glue them in position. Also glue all the joints of the frame.

Housed in a walnut case, the clock marks each hour with a tinkling tune from a music box.



Electric Clock Plays Music on the Hour

By R. J. De Cristoforo

IF YOU are looking for a project worthy of becoming a real heirloom piece, here's one with absolutely no strikes against it—an electric clock housed in a handsome case along with a Swiss music-box movement that plays music on the hour, every hour. A toggle switch mounted on the back and wired into the circuit makes it possible to shut off the music during the night if you wish.

Selection of the music movement deserves a lot of care. The unit shown has a large drum and plays two tunes to each revolution. In any event, since you will be hearing it so often, make certain you choose one that especially appeals to you and your family. Perhaps a movement can be salvaged; if not, one can be bought from a mail-order supply house.

Before starting the project, it is advisable to study the drawings and photographs thoroughly to get a clear picture of the action and construction. You will note that a pin on the clock minute-hand gear triggers the action. Revolving once an hour, this pin momentarily presses together two electrical contacts—just long enough for the music-mechanism motor to turn the music drum until two other spring contacts are pressing firmly against a brass disk on one end of the drum. This completes the main circuit, and the drum then makes a full revolution, stopping only when one of the latter contacts drops into a notch in the brass disk and breaks the circuit. When the next hour rolls around, the pin again closes the first pair of contacts and the cycle repeats.

Selection of the electric clock itself is an important feature, since it may have a face

of a size or shape that will necessitate altering the case. For this reason, it probably will be best to leave the case until last, and start by assembling the music mechanism on the sliding bottom shown in the photo and drawing at right.

Availability undoubtedly will determine your selection of a motor to run the music movement. In browsing through various stores, I found a dozen or so different motors that appeared suitable for the job. When tested, however, several lacked sufficient torque to turn the movement. I finally came across a capacitor type with a built-in gear box that turns at 2 r.p.m.—just the speed required.

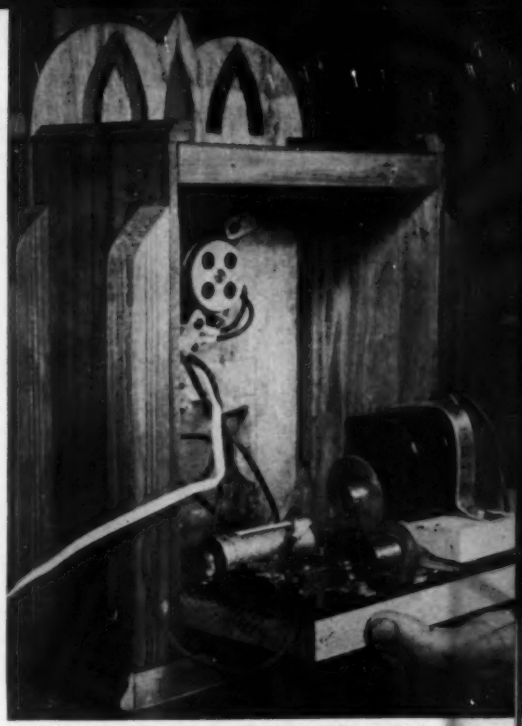
Wiring for this motor is shown, but if any ordinary motor having only two power leads is used, connect it at *A* and *B* in the drawing. If you should use a larger or smaller music unit, check the speed of the drum while turning under the original spring power and then buy or gear down a motor to turn the movement at this speed.

A capacitor was included in this circuit to make sure the induction motor would start immediately, but it is optional. A slight delay in starting should not make any serious difference.

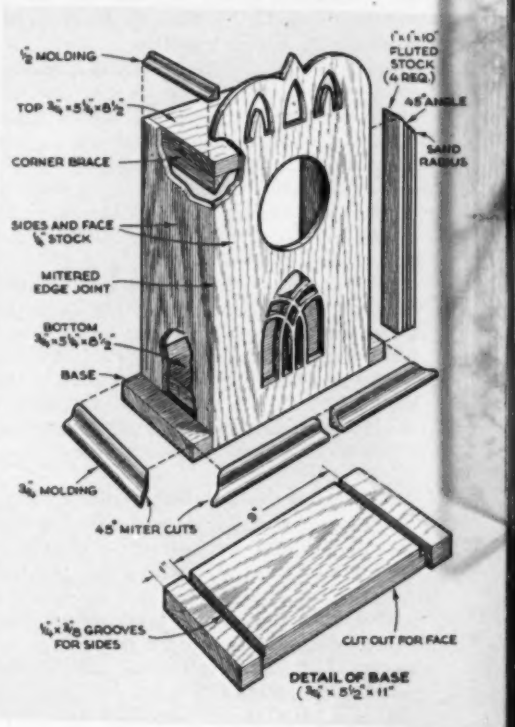
Take the music movement apart and discard everything except the drum and reed comb. The drum may be mounted as indicated in the drawing, or you may prefer to hacksaw the original casting and utilize its parts as I did. Mount the brass contact disk with two small screws after drilling and tapping suitable holes in the drum. The size of the notch in the disk is best determined after you have noted how much the motor overruns when the current is cut. Locate the notch directly opposite a blank space on the drum so the music will stop at the end of a tune—not in the middle.

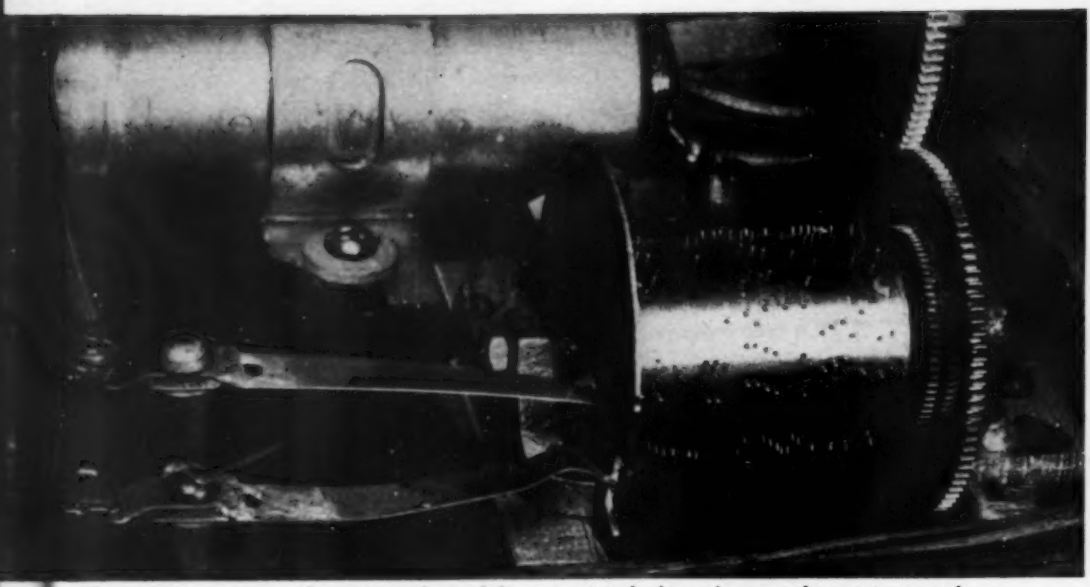
A gear also may be screwed to the drum, or if you prefer it could be soldered in place. To simplify the job, the large gear was attached directly against the original one in my clock. Before operating the mechanism, be careful to see that the motor turns the drum in the right direction, for turning it in reverse might ruin the reeds.

After the motor, gears, and music assembly are in place on the mounting board, set up the two spring contacts and apply the current while one is in the circuit-breaking notch. Then push this spring with your finger to complete the circuit and allow the drum to make a complete revolution. If the



An electric motor drives the music drum. Both are mounted on a board that is slid into place.





Two spring contacts ride against a brass disk on one end of the drum while it revolves. The circuit is broken when one drops into a notch in the disk. This stops the drum and the music.

motor overruns enough to allow the spring to jump the notch, lengthen the latter slightly with a file so that it will not.

When this part of the project is operating successfully, make the two upper contacts and mount them on a piece of wood. Then include them in the circuit and again apply the current to check the action.

It is now time to think about the clock to be used. An inexpensive kitchen model will do the job if you can find one with a face that pleases you.

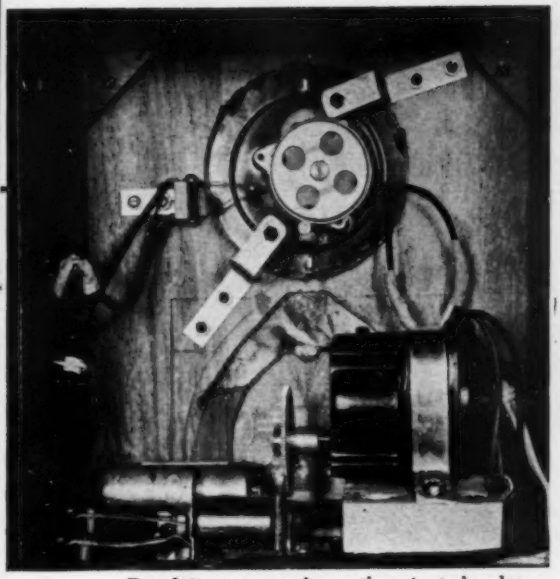
When you have located the minute-hand gear, the one that makes one revolution an hour, attach the trigger pin to it, being careful to see that the pin does not interfere in any way with the rest of the clock movement. In the clock that I used, this gear is readily accessible, but in some it may not be. This is a point to bear in mind when selecting the clock.

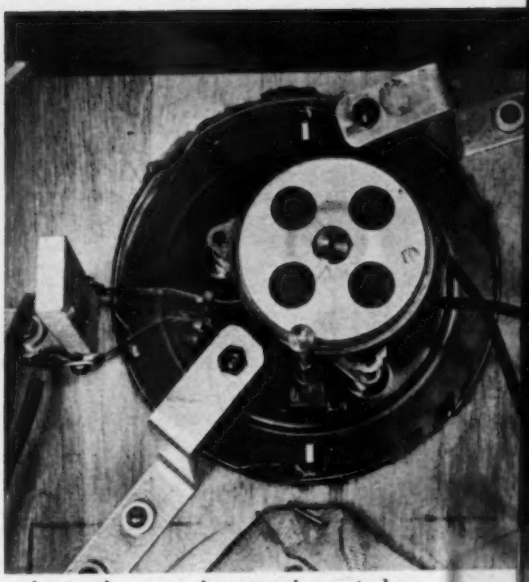
Another is the fact that in the ordinary electric kitchen clock the gears do not turn when the hands are operated manually to set the timepiece. Because of this, you will face the problem of synchronizing the clock and music movement so you will get your tunes on the hour—and not somewhere between. Such clocks can be adjusted so that moving the hands will move the gears, but this is a job that will vary with each individual clock. Rather than go to this trouble, it is suggested that when the clock and music mechanisms are complete you follow this procedure:

Apply the current until the music starts to play, but cut it off immediately. Then set the hands of the clock to the next exact hour. When another timepiece shows that this hour has rolled around, apply current and let the clock go.

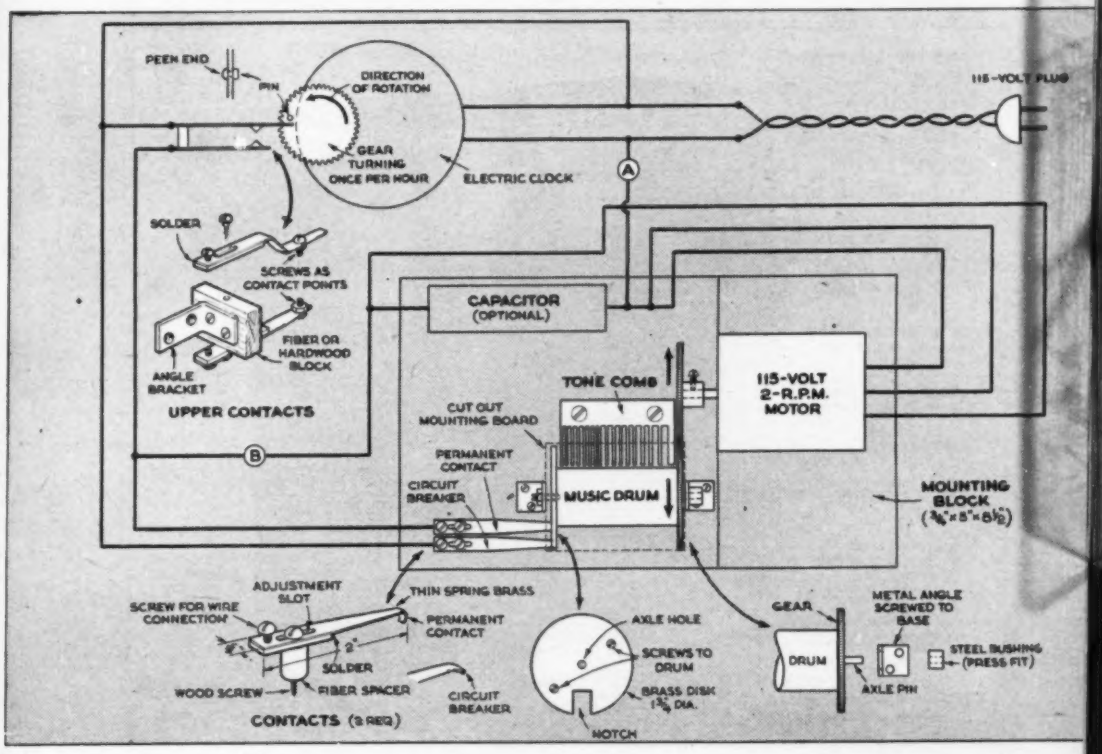
Since it is necessary to synchronize the mechanisms in this manner only when you first set them going, the setting procedure is not enough of a drawback to discourage you from using an inexpensive clock. Of course, if you have a clock in which the gears turn as the hands are set you can forget about this operation.

Straight-grained walnut with an oil finish will give the clock case a handsome appearance. After jigsawing the face of the case to the pattern in the drawing, cement a piece of tapestry cloth over the back of the lower scrollwork, and attach the clock with bent metal straps. Install two runners on the inside of the case bottom to support the music-mechanism mounting board when you slide it in or out. To soften the music tone, cement a piece of felt to the base of the mounting board. A back may be either screwed or hinged to the case. END





Revolving once an hour, the minute-hand gear has a pin that forces two electrical contacts together just long enough to start the music drum, which then makes one complete revolution.



Tired of squeezing your youngster's duds into your closet? Build him a wardrobe of his own.

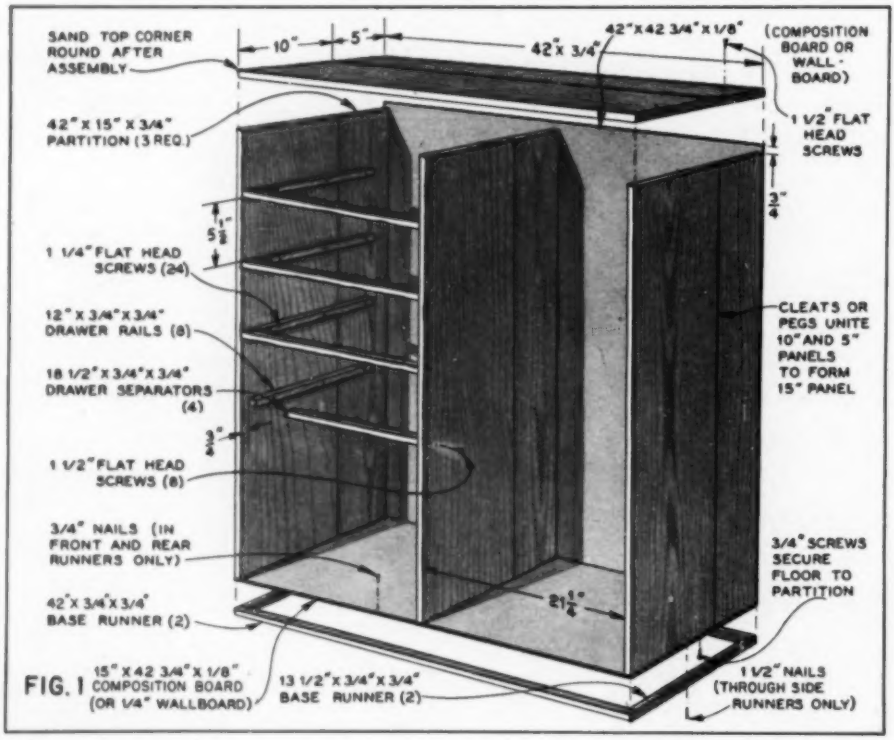


FIG. 1

Child's Wardrobe Is a Hammer and Saw Job

By Henry Clark

IF YOU'VE gotten past the stage of wondering how you are going to buy all the clothes your growing youngster needs, you have probably started wondering where you are going to put them. That's the time to dig out the hammer and saw and get to work on this handsome, modern child's wardrobe or closet.

The basic structure is shown on the facing page. Three walls are cut from ¾" by 15" stock—if wood of that width is available—or built up from 10" and 5" widths. To these a top is added, and joints are butted and screw fastened. Back and bottom are made of wallboard or composition board; cut them to size and screw them in place.

Base runners are put on next. Drawer rails consisting of ¾" square strips are then added in the left compartment. Separators are

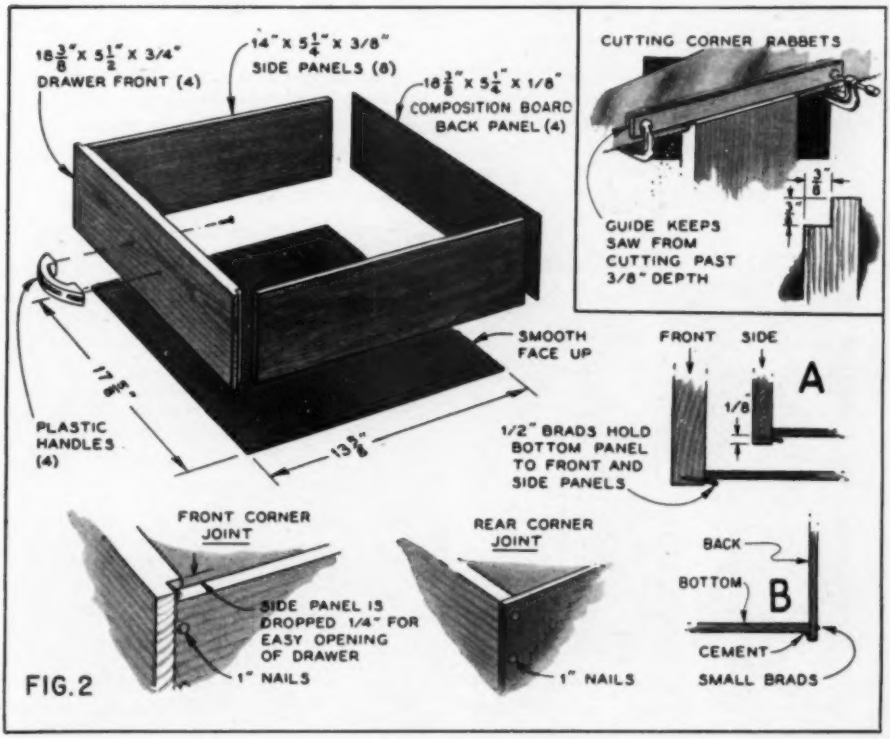


FIG. 2

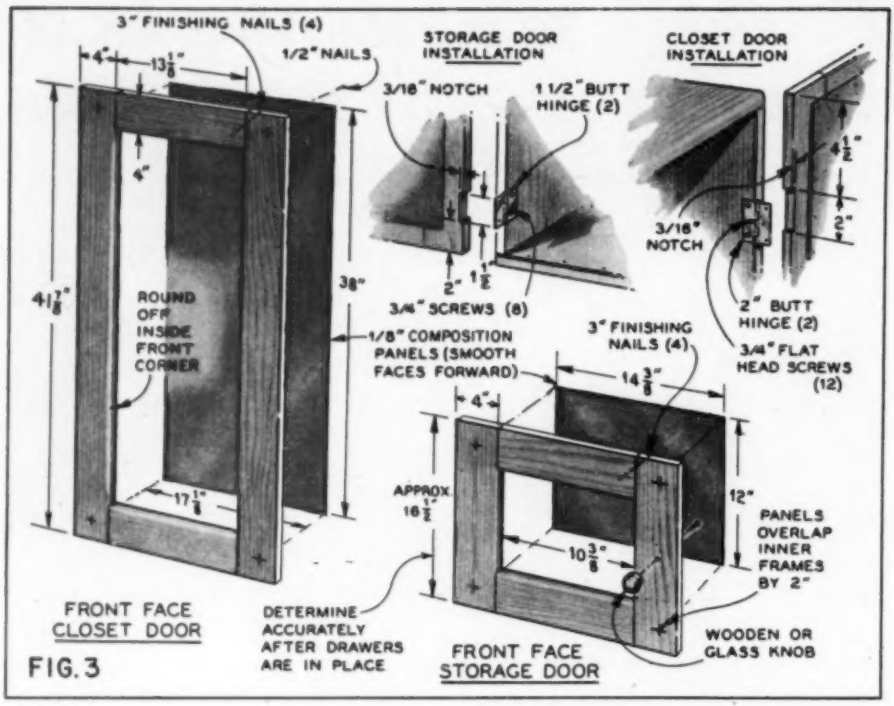


FIG. 3

butted in front of the rails and secured with countersunk flathead screws driven through the left side and center partition as in Fig. 1.

Cut the drawer faces to size—in one operation if possible—and rabbet them as shown in Fig. 2. Eight sidepieces, all exactly alike, are sawed out and squared. Backs and bottoms are made of composition board, and drawers are assembled with glue and small nails. If front, back, and sides of each drawer are properly squared, the bottom should fit snugly into the open box. Plastic handles are attached, and the drawers are put in place. Planing and filing will correct for sticking or jamming.

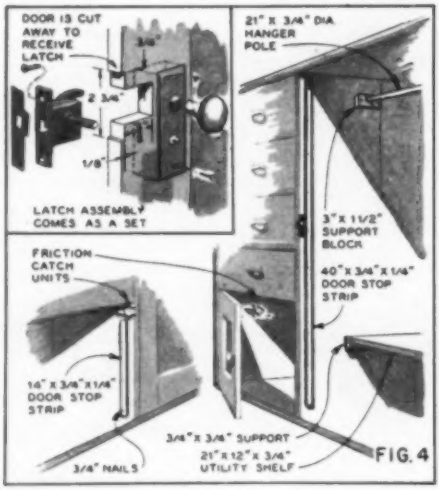


FIG. 4

You can now determine the exact height of the storage door. Cut and assemble this and the closet door as shown in Fig. 3. Butt hinges are added after their positions are determined and notches are chiseled out.

It is important to get the hinges and doors properly aligned for correct closing. A small doorknob and latch are installed as in Fig. 4, and stops are nailed in to keep the doors from swinging past the shut position. Add a friction catch to the small door, a clothes pole and utility shelf as illustrated, and the construction work is completed—unless you'd care to install a mirror in the recessed closet-door panel.

To finish the piece, round the corners of the top and sand all surfaces smooth. A coat of stain or enamel dresses up the wardrobe—and you have a piece that will serve your child for years to come. END

Kiddy Car in Tractor Style

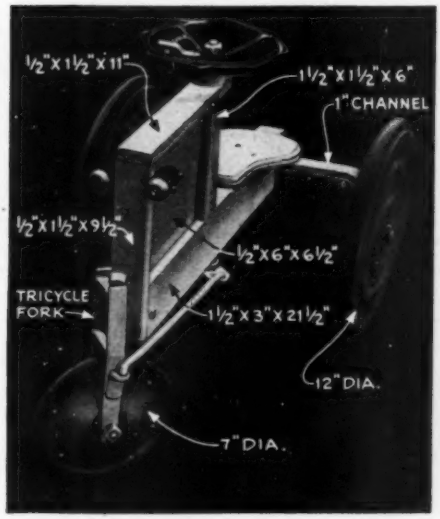
KICKED along like a kiddie car, this little tractor will give a child many happy hours. As maneuverable as a tricycle, it runs easily because of the large wheels.

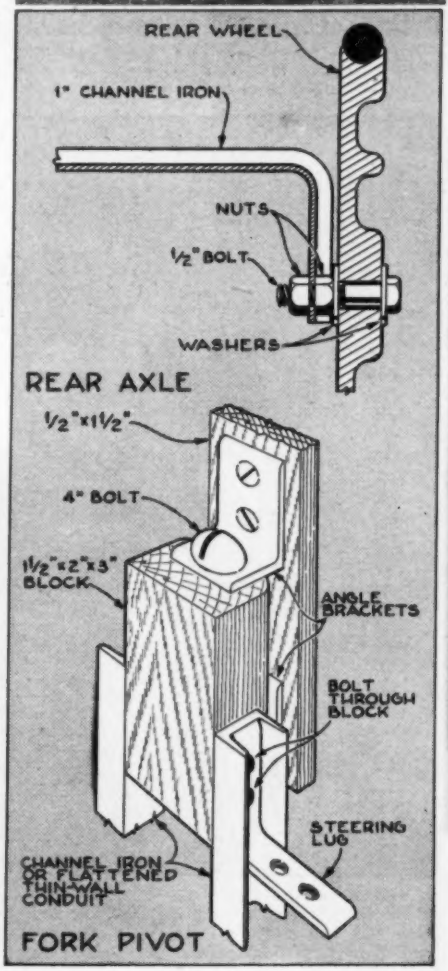
Build up the body from pieces cut approximately to the sizes in the photo below. Assemble rigidly with glue and countersunk flathead wood screws. If tricycle wheels are not available, wheels turned from maple may be fitted with rubber tires and axle bushings.

Form the rear axle from 1" channel iron, bending it to a U-shape so as to provide adequate room for the child's heels on their rearward thrust. Use sufficient length to space the wheels 16" apart. Bolt the axle fast in a notch cut in the top of the long frame member about 3½" from the rear. Over this attach a seat cut from ½" stock. Round all metal corners with a file.

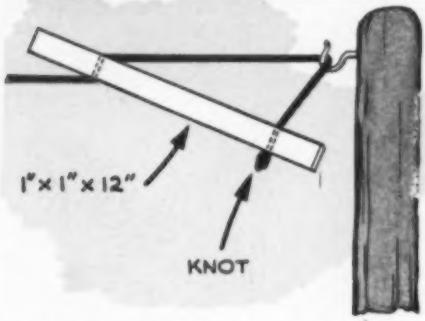
Although a tricycle fork was used in this case, a fork may be assembled as seen in the drawing. Steering is provided by a single ¼" rod, directly coupled to lugs on the fork and on an 11" steering shaft cut from ½" rod. You probably can find a suitable steering wheel on another toy.

Paint the body red and the wheels some contrasting color.—WILBER H. FULKER.





KEEPING THE HOME SHIPSHAPE

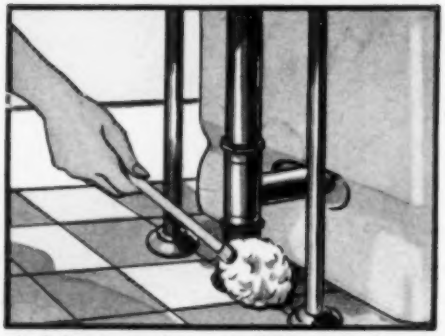


A clothesline can be taut though detachable if it is fitted with a tightener as shown. Slide the stick back until the line is tight; the weight of the clothes will keep it that way.

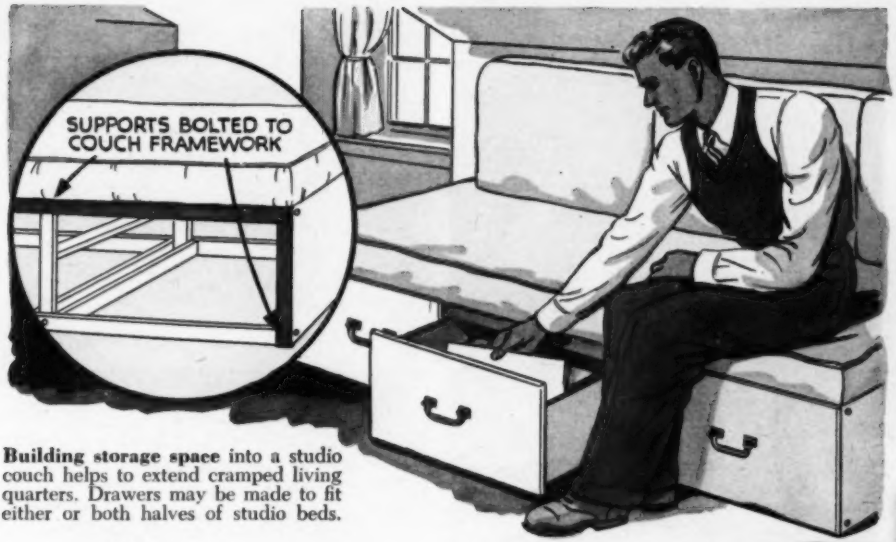
You need not discard a vase that has sprung a slight leak. Warm it, melt some paraffin, and swish this about inside to coat the bottom and sides. The waxy film will calk small holes.

If you have to take a baby out into rain or snow, wrap him in a transparent plastic tablecloth. It will keep him and his clothing dry and allow him to see what's going on outside.

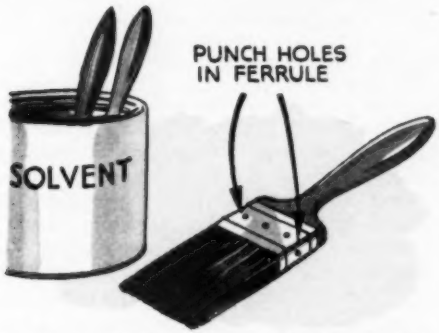
To keep grapefruit, canteloupe, and melons from sliding about on the plate, cut a flat on the bottom before serving. Be careful not to cut too deeply, or juices will escape.



A dish mop makes a good floor mop for use under sinks or wherever there isn't enough room to swing a large mop. It gets between pipes and under radiators and furniture.

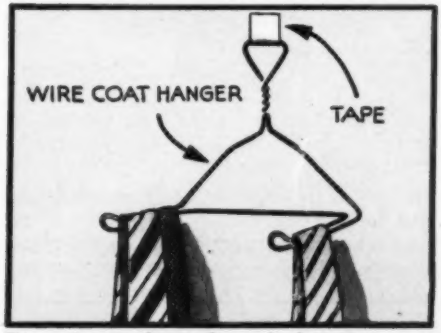


Building storage space into a studio couch helps to extend cramped living quarters. Drawers may be made to fit either or both halves of studio beds.



For faster, better cleaning of hardened paintbrushes, punch a few holes in the ferrule between the bunched bristles and the end of the handle. This lets the solvent work through.

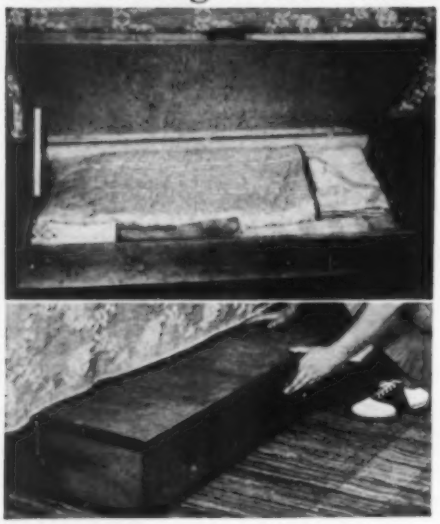
If you have trouble filling your lighter from a bottle that has no spout, obtain a screw-cap window-spray dispenser of the type shown. Cut the tube to fit the bottle and enlarge the jet.

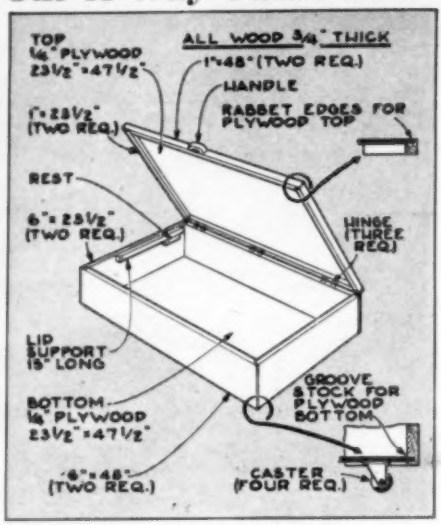


Tie racks can be made easily from wire coat hangers. Bend parallel legs for about 4" from each end; then turn the legs out at right angles. Hang the rack on the wall with tape.

Breaks or tears in collapsible tubes, such as those used for toothpaste and shaving cream, can be mended with strips of cellulose tape wrapped once or twice around the break.

Flat Storage Chest Rolls Out of Way Under Bed





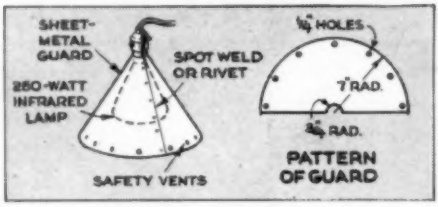
DESIGNED for use under a bed, this shallow chest solves the problem of where to store those extra blankets that overflow all available closet space. Mounted on casters, it may be moved easily when desired.

Except for the ¼" plywood top and bottom, ¾" stock is used throughout. As indicated in the drawing, the bottom is set in a ¼" groove cut ½" deep into the sides and ends ¼" from the bottom edge. Simple rabbet joints are used at the corners, rabbets ¾" wide being cut ½" deep across the ends of the 48" pieces. Assemble the box with finishing nails.

Rabbet joints also are used in making the top framework, and the plywood top is fitted flush by means of a rabbet cut around the inside edges of the frame. Attach the plywood with headless brads, and screw a handle to the front edge. Locate a lid support on the inner face of each end of the box, pivoting it on a screw at the forward end, and install a small block as a rest at the back.—ELMA WALTNER.

Infrared Lamp Speeds Up Work in Drafting Room

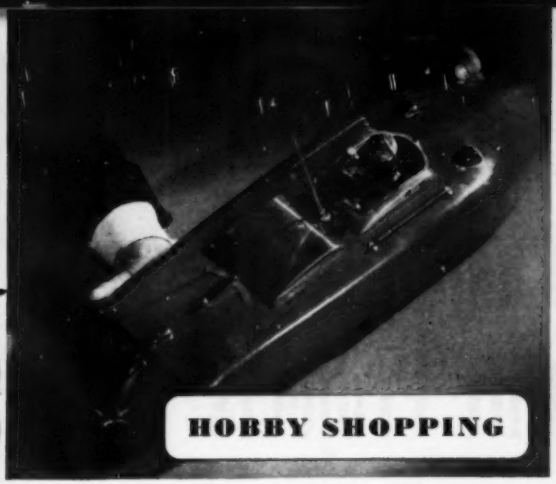
THIS simple device has opened up a production bottleneck in the drafting room where I am employed. Instead of having to wait for ink to dry before continuing a job, we now just snap on the light, hold it over the wet ink for a few seconds, and get on without the usual delay.



Because the heat is so rapid and intense, it is best to hold the lamp a bit above the surface to be dried. Since the sheet-metal shade is considerably longer than the conventional reflector, it also serves as a convenient rest for the lamp when not in use—as well as providing a safety guard in case the bulb should shatter. The holes in the shade lessen the possibility of someone leaving the light on by error.—ROBERT DELSON.

Spool Substitutes as a Level

WHEN a carpenter's level is not available, a typewriter ribbon spool makes an excellent substitute if the surface is smooth. Put down on edge, it will indicate even a very slight incline by rolling toward the area that is lower.—FRANK SHORE.



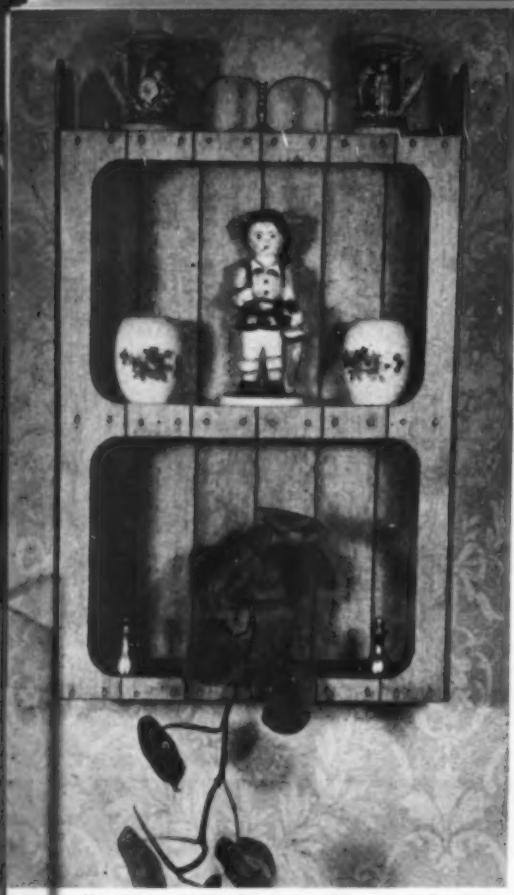
Boat Has Plastic Hull. Supplied in kit form, this speedy hydroplane has a molded plastic hull. Quickly assembled with only simple tools, the boat is 25″ long, has a beam of 7¾″, a maximum depth of 3¾″, and weighs only 34 oz. without its air-cooled gas engine. Special molded ribs increase the strength of the hull, enabling it to withstand shock and vibration. The boat is manufactured by Reuhl Products, Madison, Wis.

Cribbage Game Fits Pocket. Made of lightweight plastic, this portable cribbage set fits easily in the hand or vest pocket. Opened flat, it forms a standard cribbage board. Closed, it serves as a container for a deck of cards and the score pegs. The price is about $2, and the manufacturer is Kencroft Associates, Inc., of Buffalo, N.Y.

Fly by Thumb. A new plastic control for control-line model planes has a wheel that may be operated by thumb to raise or lower the elevators. Victor Stanzel & Co., of Schulenburg, Tex., makes the handle.

Pistol Has Various Uses. An air pistol introduced by Healthways of Hollywood, Calif., is supplied with two interchangeable barrel nozzle attachments. These make it possible to shoot corks, darts, BB's, or imitation bullets—just as you choose. Sold for about $4 with a supply of each projectile type, the pistol is accurate within 20′.

Plastics Kit Available. Materials needed for internal carving of plastics (PSM, Aug. '47, p. 160) have been assembled in kit form by the Chicago Wheel & Manufacturing Co., of Chicago. The kit includes special cutters, sanding disks, buffing and polishing compounds, polishing wheels, plastic dyes, and cements.



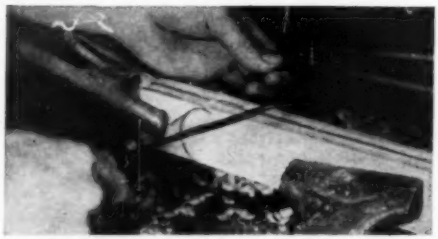
Knickknack Shelf. Painted or stained, a pair of these shelves will help dress up a bare wall.

HANDICRAFT FOR CHRISTMAS

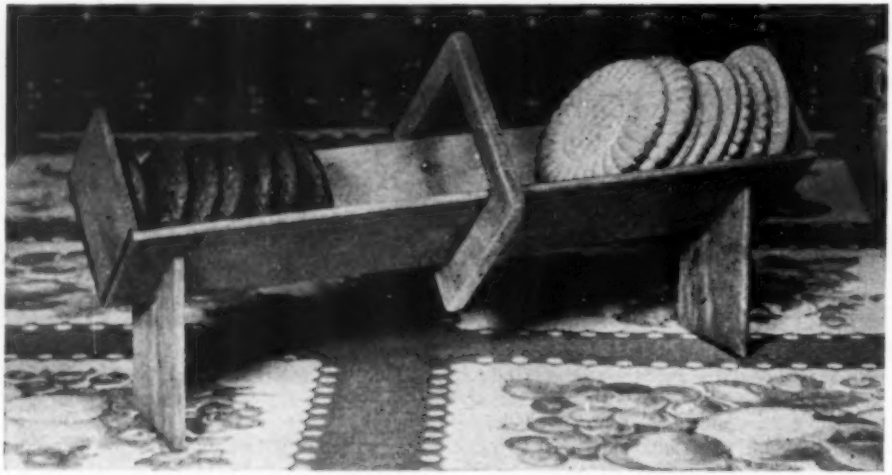
Last-Minute Gift Projects

Here are seven handsome home accessories that you can make in a jiffy from a few Venetian-blind slats.

By R. J. DeCristoforo



Several slats may be sawed simultaneously if clamped in a vise. Sandpaper the cut edges.



Cookie Server. Although dainty and fragile in appearance, it is quite strong. The handle is a square frame cut from ¼" stock. Remember to slide the handle on before attaching the feet.

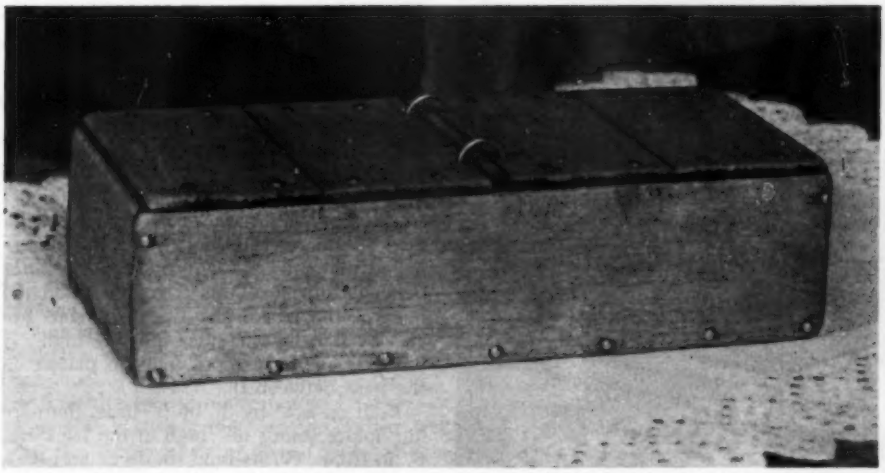
Candy Tray. The lid in the center covers a narrow receptacle that may be used to store matches or other small articles. Cleats under the lid will prevent it from sliding off the box.

QUICKLY made at little cost, these gift items all use new Venetian-blind slats. Made of good wood, such slats are a pleasure to work with, for they come in various widths, have nicely rounded edges, and are smoothly finished, ready for staining or painting. A local Venetian-blind manufacturer probably will sell you cutoffs for a few cents, or failing that, you can buy a supply from a mail-order house.

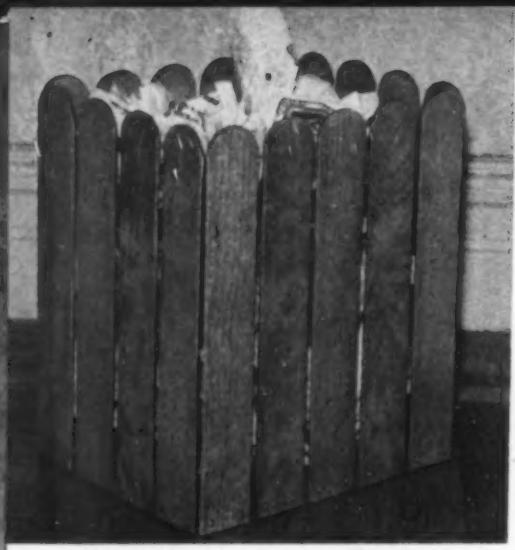
The slats may be worked with just a few simple tools. A coping saw is good for cutting curved pieces. When it is necessary to make a lengthwise cut, a sharp knife and a straightedge will do a good job. Edges may be smoothed and rounded with sandpaper, and sandpaper wrapped around a block enables you to make bevels where desired.

Simple butt joints and brass escutcheon pins were used in making the projects pictured. To avoid splitting the wood, it is best to drill small holes for the pins. For greater strength, coat mating areas with glue before driving home the pins. Although slats take paint readily, the seven projects were finished in this case with a maple oil stain and then waxed.

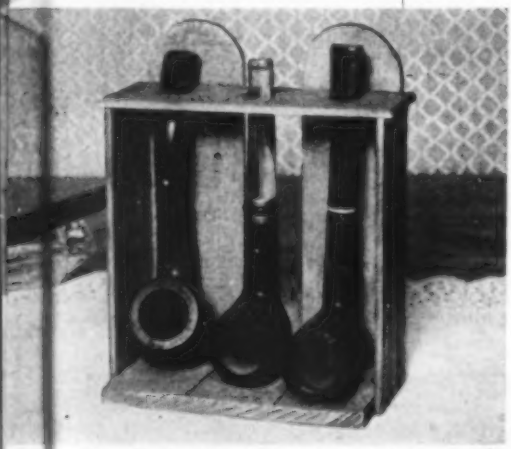
The wall shelf is large enough to be a unit on its own, yet of a size that will permit hanging in pairs. It is 17″ high and the width of six 1¾″ slats loosely spaced. Two



Cigarette Box. Two brass rings hinge the two lids, the rings being placed in holes drilled in the lids and center partition. A cleat on each lid would make it easier to open the box.



Wastebasket. Lined with cardboard, it may be used to empty ashtrays, but watch live butts.



Pipe Rack. Lengthen to take additional pipes if the man who'll get it has more than three.

Napkin Holder. A natural finish and the heads of brass pins give it an old-time appearance.

slats butted together make the 3½″ sides. All are nailed around three shelves cut from ½″ stock and spaced 6¾″ apart. It would be wise to lay the slats side by side to the required number and measure them so that you can cut the shelves to suit. The pieces used to edge the front of the shelves are ½″ lengths cut from 1¾″ slats.

A 1⅜″ slat is butted against the edge of a 1¾″ slat to form the trough of the cookie server. The ends are 1⅜″ squares butted inside the trough, and the uprights are 1¾″ by 2½″ with a 90-deg. notch. Made of a 2¾″ square of ¼″ stock, the handle is cut out in the middle to fit the trough. The joints may be glued.

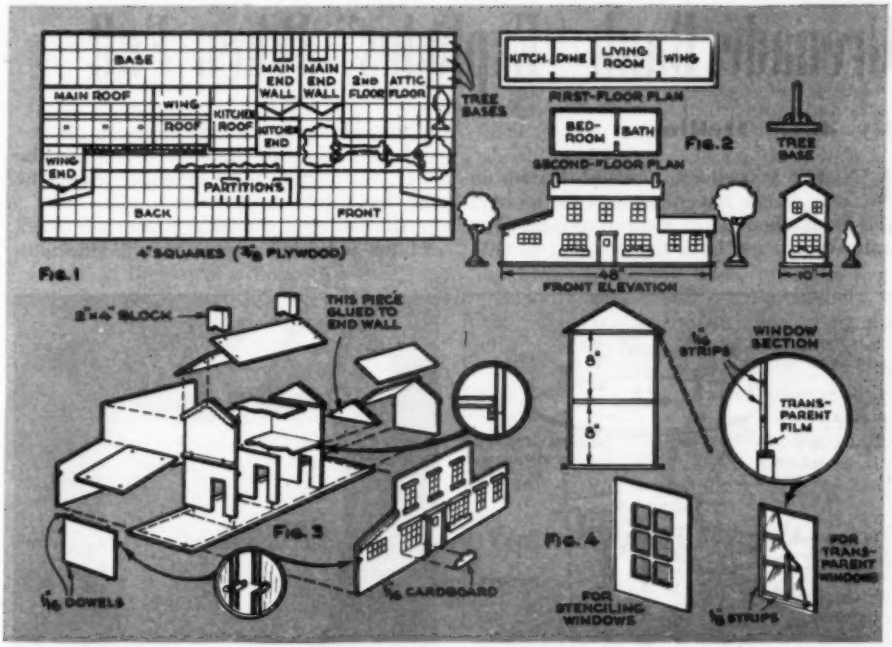
For the cigarette box, sides and ends 1⅞″ wide are fitted around a bottom of ¼″ stock, forming a box 3¼″ by 7½″. A partition is fitted midway, and the two lids are hinged to this with brass rings. Small holes should be drilled simultaneously in both covers and the partition so that the brass rings line up perfectly. The lids each are made of two pieces joined by cleats below.

The candy tray is a structure similar to the cigarette box, but the sides are cut on a slope and two partitions and a loose-fitting cover form a closed receptacle in the center. A piece tacked underneath keeps the lid from slipping. Outside dimensions of the tray are 5¾″ by 10¼″.

For the bottom of the wastebasket, cut a square from ¾″ stock. Slats 12″ long are nailed to it and to a square framework located 9″ from the bottom. This frame may consist of ¾″ square stock assembled with butt joints. For uniform spacing of the slats and a pleasing effect, it's wise to lay the slats on a flat surface, spacing them as desired. Then measure across them and cut the bottom and frame accordingly. In this case, 1⅜″ slats were spaced ¼″ apart.

Simple and pleasing in design, the pipe rack has a 2⅜″ by 4½″ base, cut from ¾″ stock. The slat framework is strengthened by a ¼″ square cleat (not seen in the photo) nailed under the 1⅞″ by 5″ top, the latter being beveled on three edges to soften the lines of the rack. The two back slats are 1⅞″ by 6″ and the sides are 4¾″ high. If desired, small partitions may be placed on the base between the bowls.

Built on a ¾″ by 3″ by 6″ base, the napkin holder stands 6½″ high at the back and 6″ in front. Cleats hold the front and back slats together. Rounding all edges improves the appearance. END



All structural parts of this doll house are cut from a single 4′ by 8′ sheet of 3/8″ plywood.

Four-Foot Doll House Stores Flat

By Hi Sibley

THERE must be some little girl on your Christmas list who has written to Santa for a real big doll house. Her mother probably didn't mail the letter because she knows that a big house for daughter's dolls won't leave much space for the rest of the family. But Santas who know all about housing shortages and small apartments can please both generations with a house that can be folded away in a jiffy.

One panel of 3/8″ plywood supplies all the material needed except for dowels and a few strips of pine. Lay out the pieces as shown in Fig. 1. Appearance of the completed house is illustrated in Fig. 2. The front wall lifts off to give access to the interior.

Assemble the pieces as shown in Fig. 3. Small dowels with rounded ends are installed where indicated, and slightly larger holes are drilled in the matching pieces. End walls of the two-story part and of the wing and kitchen are dowel-fastened to the base, and the rear wall is added. Put in the partitions and floors, and then the roof and chimneys. The front wall goes on last; both it and the rear wall are secured by turn buttons as shown in the lower inset detail of Fig. 3.

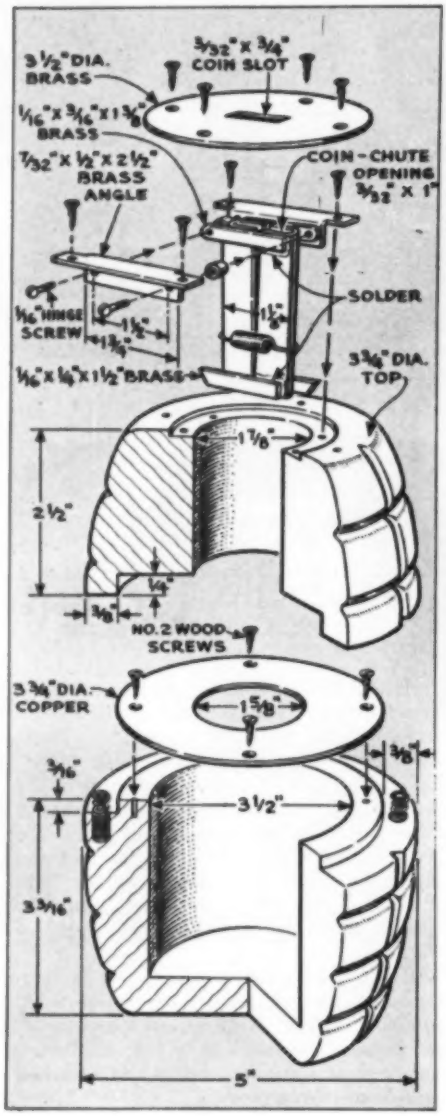
If you want a simple job, stencil the windows in blue and put a frame of thin wood around the door. Transparent windows set in openings are made as in Fig. 4. Carved valances and window boxes are attached with brads and glue.

Grenade Bank "Explodes" When Full

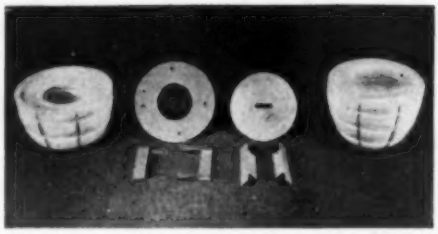
By Jack Mellinger

UNLESS you choose to smash it with an axe, you'll never succeed in robbing this bank when you're short of change. The only way to get back the pennies, nickels, or dimes already in it is to put in more—and more—until the bank is full. Then, the last coins unlatch the mechanism and allow the two halves to fly apart.

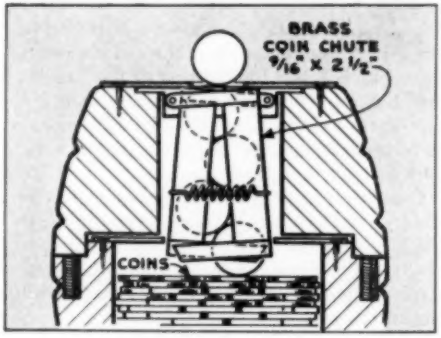
After turning the halves from softwood, cut the indicated grooves in the side with



When the bank is full, the final coins force the chute halves apart, letting the bank open.



All the parts are pictured above. In the left foreground are the two halves of the chute.



a rasp and drill 3/16″ holes in the lower half for two springs. Form the coin chute from two 1⅛″ by 2½″ pieces of 20-gauge brass. Bend each lengthwise to a U-shape so as to form an opening just wide and long enough to take a nickel when the two pieces are placed edge to edge.

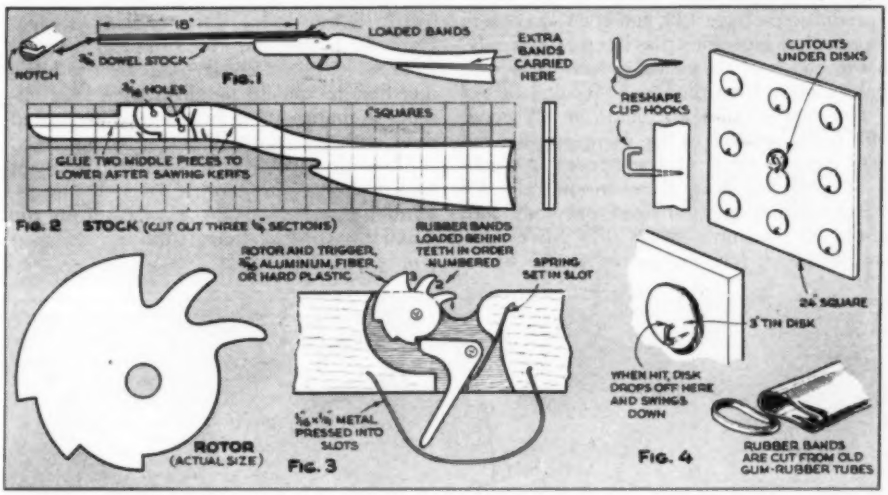
Examination of the drawings will show that the chute halves are pivoted at the upper end, a small spring holding them together at the lower. Make two 3/16″ by 1⅜″ hinge bars from 1/16″ brass, and solder one bar to the side of each chute half at the upper end. Solder 1/16″ by ¼″ by 1½″ lock bars to corresponding sides of each chute half at the lower end. Note that each lock bar is filed at an angle at the outer end.

Two brass angles support this assembly, the chute halves being hinged on 1/16″ screws fitted with small bushings. Attach the angles to the upper half of the bank with flathead wood screws.

Cut the inside locking ring from sheet copper and fasten it to the lower half of the bank with flathead wood screws. You should now be able to snap the two halves together. If the lock bars fail to snap into place, you can probably remedy the difficulty by placing a cardboard ring under the locking ring to raise it slightly. If the bank halves are too loose, raise the angle plates slightly with cardboard shims. At this point, you can unlatch the mechanism with a small, thin screwdriver.

In the top plate, drill and file a coin slot that will just pass a nickel, being careful to locate it directly over the chute. Attach the plate with flathead screws, countersinking the heads. Then fill in with solder and smooth with emery paper.

Repeater Rubber-Band Gun Gets "Big Game"



HERE's a rubber-band gun that looks like a gun, cocks with a click, and shoots three bands one after another on one loading. By making several of these guns and a target panel, on which pictures of big-game animals are revealed when the flying bands knock aside covering disks, you will have an interesting indoor game.

Lay out the pattern of the stock on three sheets of ¼″ plywood bradded together. Then drill the two 3/16″ holes and saw the stock to shape. Now separate the three sections of the stock. Cut away part of the middle one to accommodate the trigger and rotor. Also make saw kerfs to take the trigger spring and guard.

Glue the two pieces of the middle section in their original position on one of the solid sections. After installing the rotor, trigger, and spring, put the other section on temporarily to see that everything works. If it does, glue this section in position. Notch the back 4″ of the barrel to fit the stock and attach with two 1½″ countersunk wood screws after gluing. When you use the gun, squeeze the trigger slowly.—R. R. COLE.

Youngsters who like action in their toys will enjoy making these tireless spike drivers work.

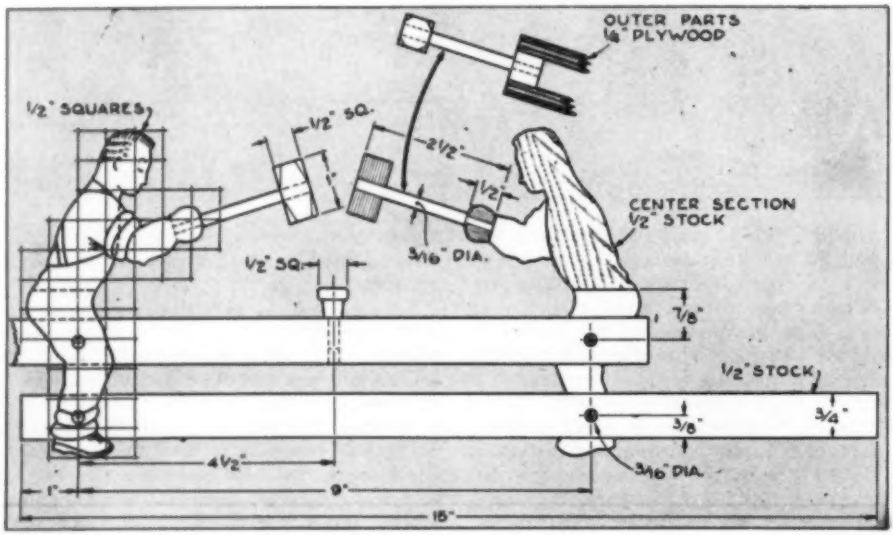
Toy Workmen Drive Spike

MECHANICAL toys seem so much a product of our own century that it may be hard to believe this one originated around 300 years ago. In the tavern scene reproduced on page 129, Jan Havicksz Steen depicted an ingenious plaything held firmly in the hands of its young owner. You can make a copy from pine and plywood.

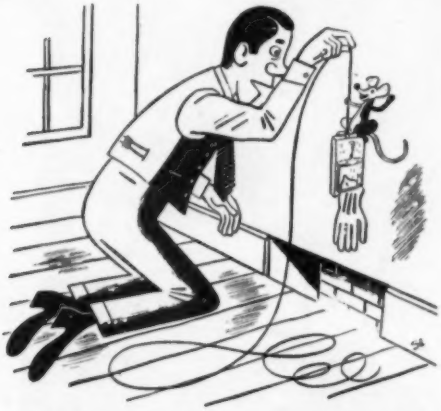
The two handles are made of ½" wood with holes spotted in the same position on both pieces. Each of the figures is made of ¼" plywood sides glued around the ½" center sections used for head and body and hands. If you have access to a power jigsaw, make all four sidepieces at one time.

Assemble the figures with glue and sand and shellac them carefully. Drill 5/32" holes into the center of the hands to hold the hammer handles, and also drill scant 3/16" holes through the legs as shown. Hammer heads and the spike are shaped from ½" stock. Dowels used for the hammer handles should be cut a trifle long initially so that they can be trimmed as needed until both hammers hit the spike squarely.

Give all parts a final sanding. Apply a coat of shellac and allow it to dry before assembling the moving parts. Paint in the detail and color as indicated in the photo on page 129.—JAMES J. O'HARA.



WHAT'S YOUR I.Q.?



Mousetrap Garners Gauntlet. While insulating my attic, I dropped a work glove into a partition. It came out promptly when I sent a string-suspended mousetrap down after it.—HOWARD A. GUNDERSON.

Freezing Holes in Rubber. I can't drill or cut sponge rubber cleanly when it's soft, but by soaking it in water and then freezing it in dry ice, I get a crisp, workable material. The drill or saw must also be kept slightly chilled.—RONALD J. MCKENZIE.

To find the fuse for an outlet with the least stair climbing, I plugged in a nonself-starting electric clock synchronized with my watch, and then downstairs pulled one fuse a minute. The time on the stopped clock told me which it was.—DONALD STEWARD.

Saw Stretches Shelf. And it needed stretching, too, because the cabinet to be fitted measured 36" while the longest board I had was only 30". To make it bigger I cut it down as shown. The center piece moves back, the edge is sawed off, and I have an indented shelf.—A. RICHARD FISKE.

Have you pulled off a smart one lately? We will pay for acceptable contributions showing ingenious solutions of problems in the home, shop, garage, or camp. It doesn't matter if it's wacky—if it works.

Wrought-Iron Tables Have Glass Tops

By John P. Arnold

A GLASS-TOPPED wrought-iron table in either of the two designs shown here will quickly make a place for itself in the household. Impervious to weather in a terrace, porch, or garden spot, it's equally at home indoors as a serving table, a plant stand, or simply a side table. When not needed, it can be disassembled by removing two bolts and compactly stowed away.

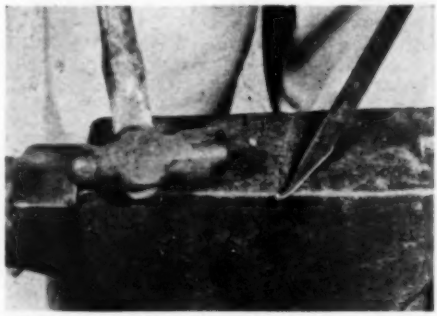
Dimensions on the drawing are for a 24" by 32" glass top, but the length can be altered to suit. Whatever size you decide on, get the plate-glass top before starting work. Unless you are familiar with glass work, it's best to buy it cut to size with the edges polished. Legs should be not smaller than ⅜" square mild steel. You'll also need some flat bar stock for rails and stretchers. Aluminum might be used instead if available.

In making the cross-leg design, it's well to lay out a full-sized plan on paper and mark the half-lap joints from this. Cut the legs to length, lay them on the plan, and transfer the lines of the joint, which can be worked out with hacksaw and file. It should be a good push fit, without looseness. Drill through for the stretcher bolt.

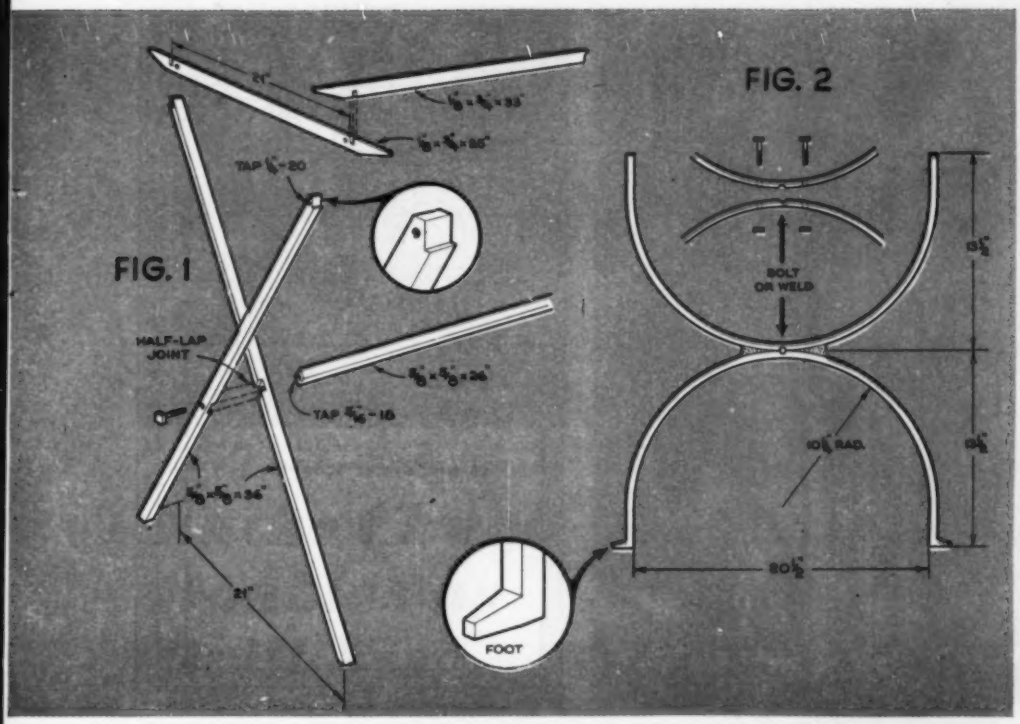
If you prefer the half-round legs, lay out a full-size pattern of the curve and check the work against it frequently while bending it to shape. Form feet on the lower sections by heating red hot and upsetting the metal with a hammer to the form shown in the drawings. Join the two halves of each leg by welding, brazing, or bolting as shown in the drawing. In the latter case, fillets may be formed and gaps filled with iron furnace cement.

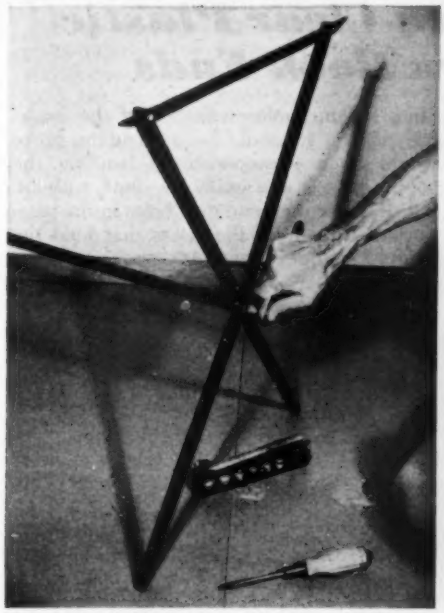
Both upper ends of either type of leg are drilled and tapped. Cross rails are fastened with bolts and notched half their width from the top edge to form half-lap joints with the top stretchers. Notch the latter accurately so that the joint beneath the glass is flush. Bent-up tips on both members, formed as shown below, hold the top from sliding off.

The lower stretcher is drilled and tapped at both ends. If means are available, it can be twisted as in the photo above.



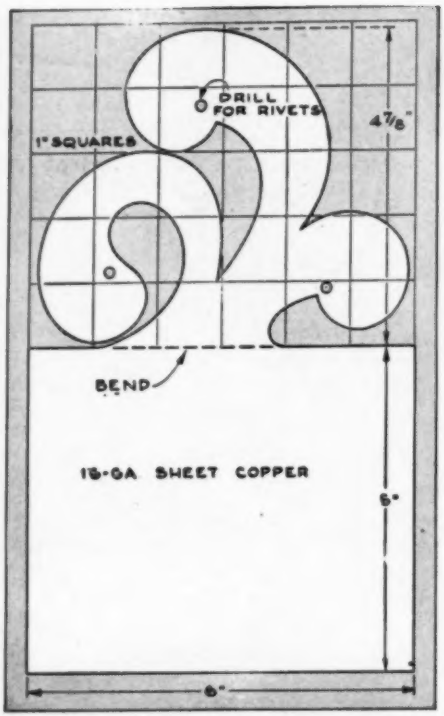
Tip up rail and stretcher ends by hammering to form lips that will keep the top from sliding.





Two bolts hold the top rail. The stretcher is secured with a bolt through the half-lap joint.

Notch top rails and stretchers accurately to form a flush joint for the glass to rest upon.

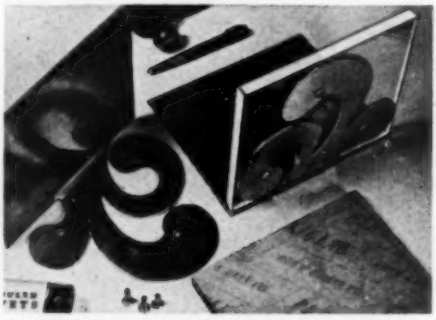


Copper Overlay on Clear Plastic Makes Modern Book Ends

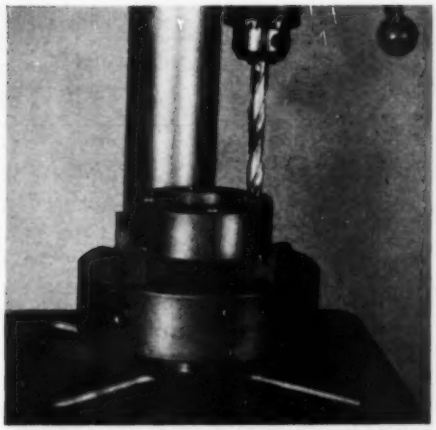
GLEAMING copper and clear plastic are combined in this distinctive pair of book ends. The contrasting materials and simple design make them an appropriate accessory for use with modern furniture. Two 5" by 6" pieces of ¾" clear plastic, two 6" by 10" pieces of 16-gauge sheet copper, and six ¼" tubular copper rivets are the required materials.

After cutting, smooth all the edges of the copper and plastic with a file. There will be less chance of marring the plastic if the filing is done before removal of the masking paper. If available, a bending brake would be a convenience in bending the copper, but it can easily be done without. Polish the copper, and drill holes in the plastic and copper for the rivets that hold the pieces together.—DORIS ALLER.

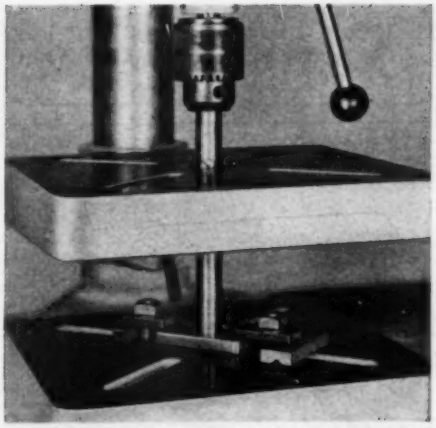
Cut the copper to shape on a jigsaw, or if this is not available, a jeweler's saw may be used.



Tubular copper rivets are used to attach the copper overlay to the piece of ¾" clear plastic.



Chucked on the table, lathe work can be drilled with holes accurately parallel to the turning axis.



This boring setup enlarges the center hole of the drill-press table. Note the lower bearing.

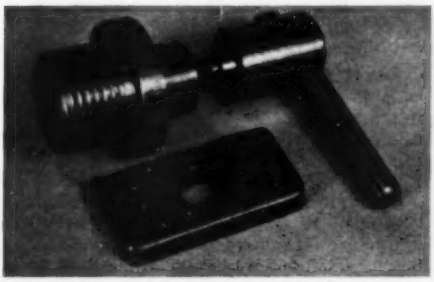
Lathe Chuck Doubles as Drill Vise

WITH this adapter your lathe chucks and faceplates can be used on the drill-press table, often without disturbing the way the work is chucked or clamped. Lathe work can be transferred to the press with assurance that all drilled holes will be parallel to each other and to the axis of turning, and at exactly 90 deg. to the face. Any desired drilling location can be selected by a combination of table swing and rotation of the chuck or faceplate.

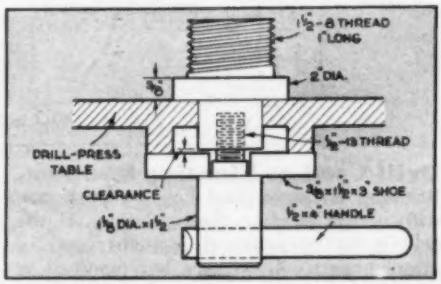
For accurate results the center hole of the table must be bored round and free of taper. The setup shown above does this nicely. I used 11/16″ bar turned down to ½″ at one end for the drill-press chuck, and cross-drilled twice for a ¼″ lathe bit and setscrew. A hole in a plate bolted to the base table serves as a lower bearing for the boring bar. I enlarged the center hole to 1⅛″, taking a series of light cuts at low speed.

The adapter parts are straightforward machining jobs. Check the dimensions against your drill-press table, and thread the spindle nose to fit your chucks and faceplates. Turn the spindle nose so that it will make a free push fit in the bored-out table hole. Be sure there's at least 1/16″ between the spindle end and locking plate.

Chips can be kept out of a chuck by placing a paper "apron" on the work and drilling through it. On through holes, damage to the chuck or faceplate may be prevented by the use of a pad of scrap metal under the work.—JOHN A. BATES.

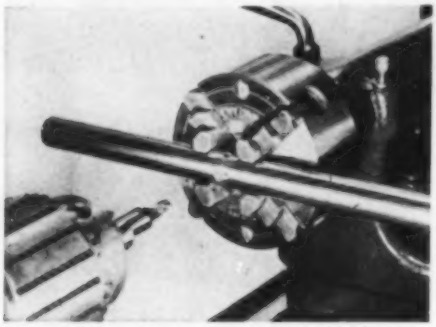


These three parts are all you need to mount lathe chucks or faceplates on the drill press.



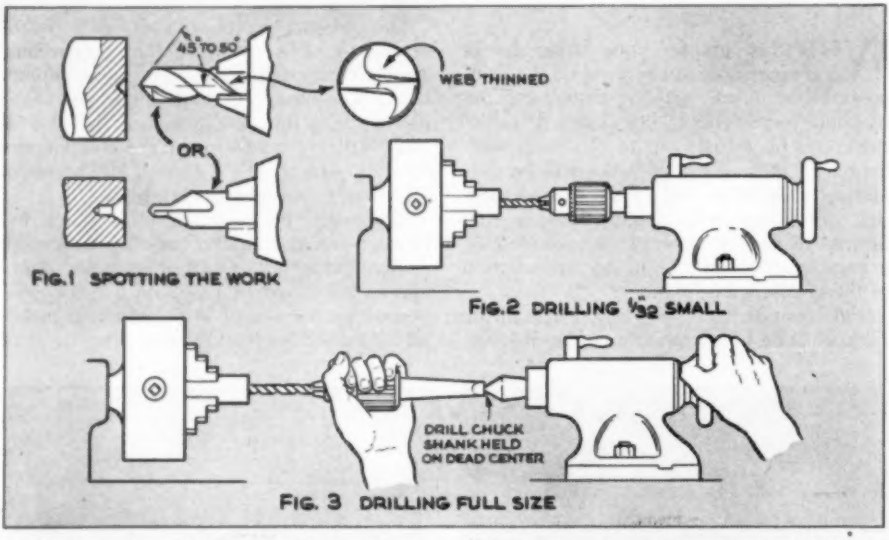
No critical dimensions are involved, and ordinary cold-rolled steel will do as material.

NEW SHOP IDEAS



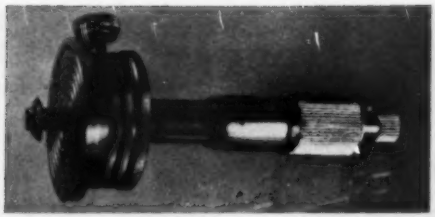
Vise for End Milling. I tried counterboring a hole in a boring bar by holding it on the drill press in V-blocks, but the bit caught on a transverse hole tapped for a setscrew and would not stay true. Finally I gripped the bar in the four-jaw chuck on the lathe tailstock and fed it against an end mill, with good results.—H. L. PHILLIPS.

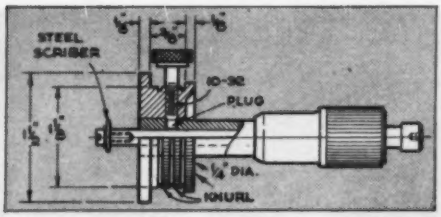
Shield Illuminates Fine Work. If you have a grinder with an illuminated safety shield, you'll find this ideal for delicate work such as assembly, fine hand grinding, and carving, for it gives needed light and protects the eyes. The one above, mounted on a heavy base, is detachable for replacement on the grinder.—J. P. ARNOLD.



Drill Used as Floating Reamer. Reaming an undersized hole to finish size with a drill is often disappointing. If the drill is rigidly mounted, a slight bend or misalignment will create a bell-mouthed or tapered hole. However, steel sleeves have been drilled with true holes up to ½" in diameter by a routine method as follows:

The hole is spotted with a stubby drill reground as shown or with a centerdrill (Fig. 1). It is drilled 1/32" small as in Fig. 2. The reaming drill is mounted in a taper-shank chuck held as in Fig. 3. Floating action permits it to center itself perfectly.

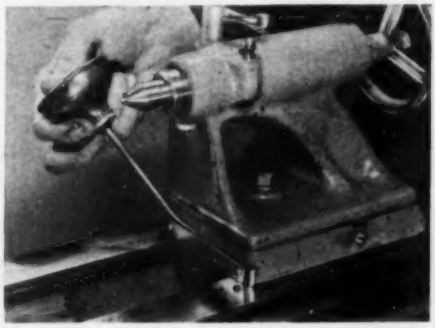


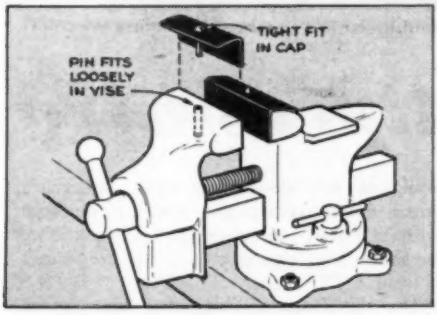


Scriber Has Mike Adjustment. An inexpensive micrometer with the frame cut off forms the heart of this scriber and depth gauge. The spindle was annealed, both ends centerdrilled in the lathe steady rest, and the barrel mounted between centers. With a sharp tool and very light cuts it was turned true along ⅝" of its length.

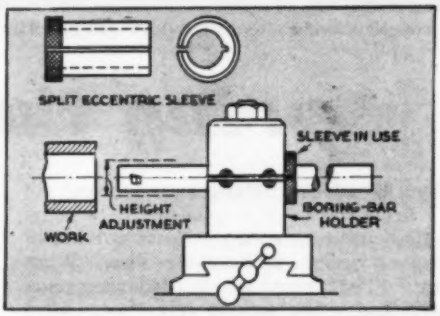
The head was rough-turned, drilled 1/32" undersize, knurled, and then reversed in the chuck to finish-turn the face and bore the hole a light press fit for the barrel. This was pressed in and a hole tapped for a setscrew and a hardwood plug that lock the spindle. The spindle was lapped flush with the face at the 1.000" reading, tapped, and fitted with a spring-steel scriber. Settings are the difference between 1.000" and the reading. For depth measurements, add the scriber and screw thickness.—PAUL T. CLEMENTI.

Tailstock Wipers Clean Ways. Chips trapped under the tailstock when it's loosened and reclamped may throw it out of alignment or embed themselves in the ways. It's a simple matter to equip the tailstock with wipers like those used on carriages. A band of 1/16" by ½" stock is shaped to the casting and drilled near each end. Spot the band about 1/16" above the ways, transfer the holes, and tap 6-32. Attach the piece with two screws and a strip of felt low enough to ride on the ways. Soak the felt with oil.—RICHARD HANSCOM.

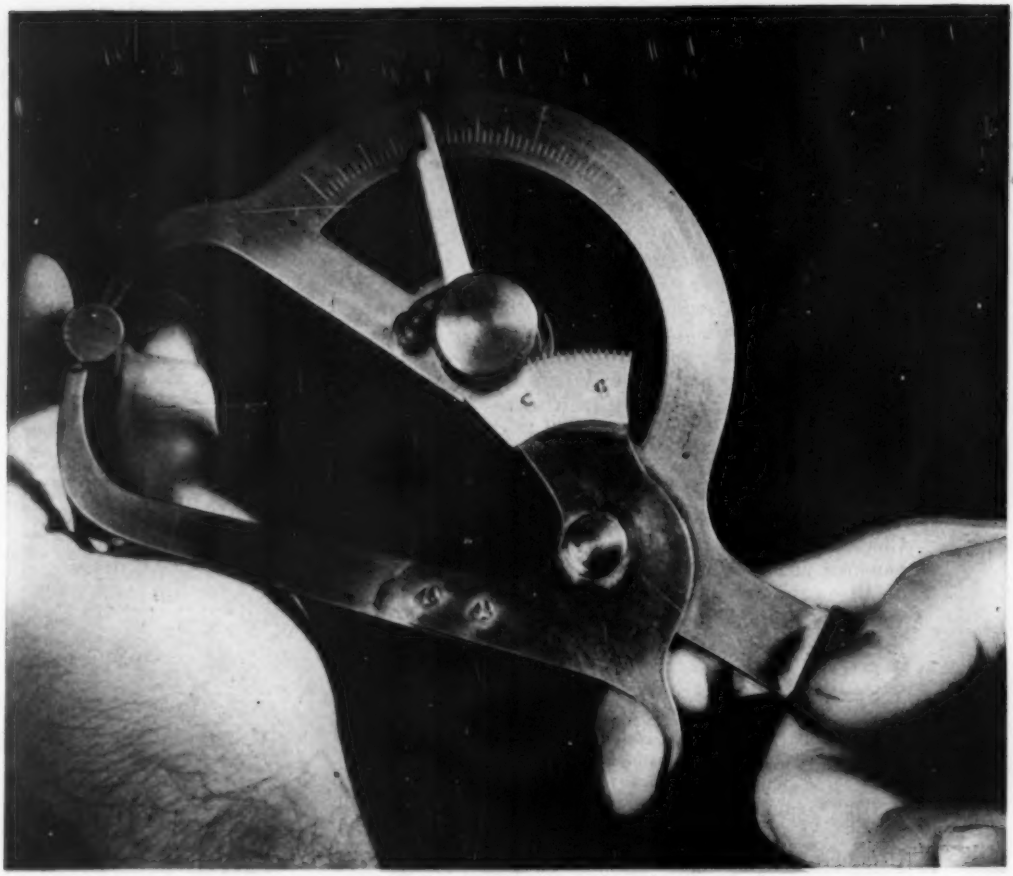




Soft Jaws Stay Put. Slip-on vise jaws used to prevent marring are awkward and always seem to drop off when your hands are busy. Pins set in them end the trouble. Spot a hole in each at the same position, clamp both in the vise, and drill the holes through into the vise jaws. Secure the pins in the loose jaws by screwing, riveting, or soldering them.—JOHN A. BLAKER.



Sleeve Adjusts Boring Tool. Many boring-bar holders have no height adjustment. The split eccentric sleeve shown gives a good range, a twist raising or lowering the bar while keeping it perfectly level. Turn the sleeve outside, knurl the collar for a finger grip, and chuck it off center in the four-jaw to drill and ream the offset hole. Mill or saw the slot.



Spring-tensioned jaws gauge work quickly. The double-size scale makes for reading accuracy.

Spring Calipers Give

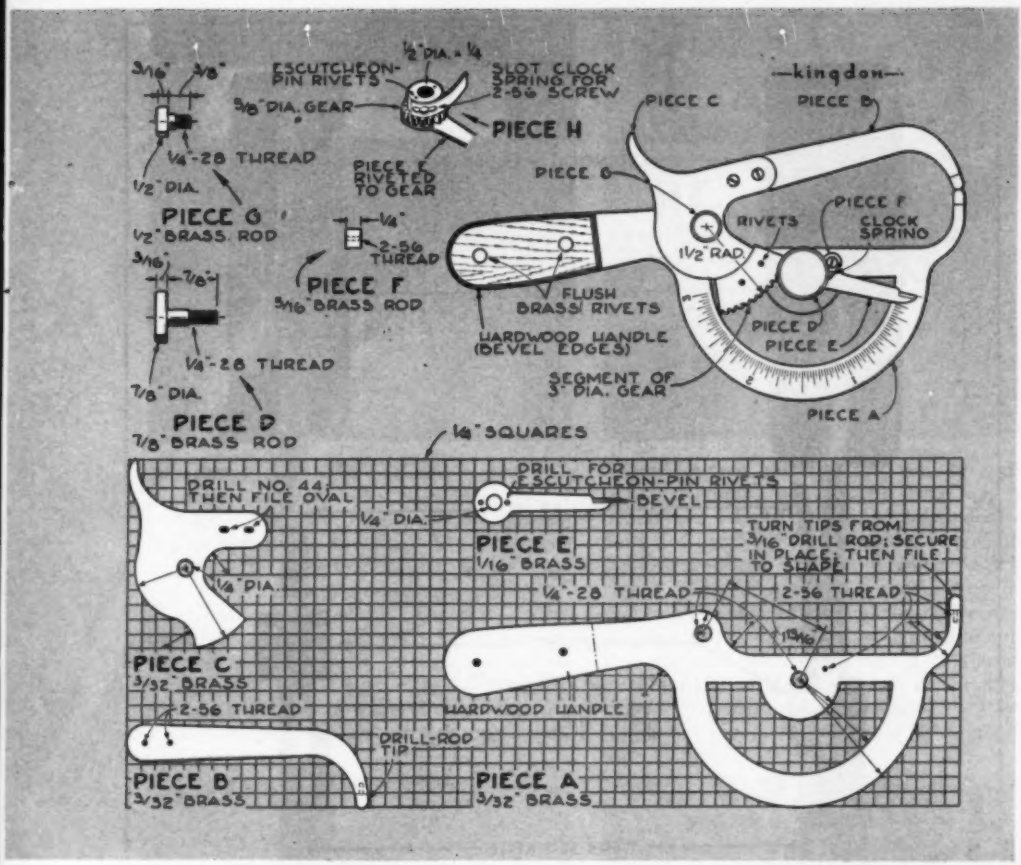
By Herbert Pfister

PICK up these spring calipers and you've got a reading before you can say, "What size?" The geared pointer indicates on a magnified scale, making it easier to read small fractions. It's a fascinating job to turn out this toolbox gadget.

You can save time by getting some ¼" graph paper instead of drawing the ¼" squares. On this, trace the patterns for pieces *A*, *B*, and *C* by following them from square to corresponding square. Cut out and paste the patterns on 3/32" brass to minimize waste. A metal-cutting bandsaw or jigsaw will make short work of cutting, but if you are patient the work can be done with a stout metal-cutting blade in a jeweler's or a coping saw. Cut the pointer *E* from 1/16" brass.

Do all filing, drilling, and tapping on these parts first. Secure leg *B* to piece *C* with two 2-56 screws. Place a 3" gear that has a ¼" hole (or is bushed to that size) on ¼" rod set in the hole in piece *C*. Drill through this and the gear for two rivets. Cut out a 1½" gear segment with the holes and rivet it on with escutcheon pins.

A detail at the top of the drawing shows how the pointer *E* is riveted to the hub of



Turned studs *D* and *G*, which serve as pivots, thread into *A* and are locked with nuts beneath.

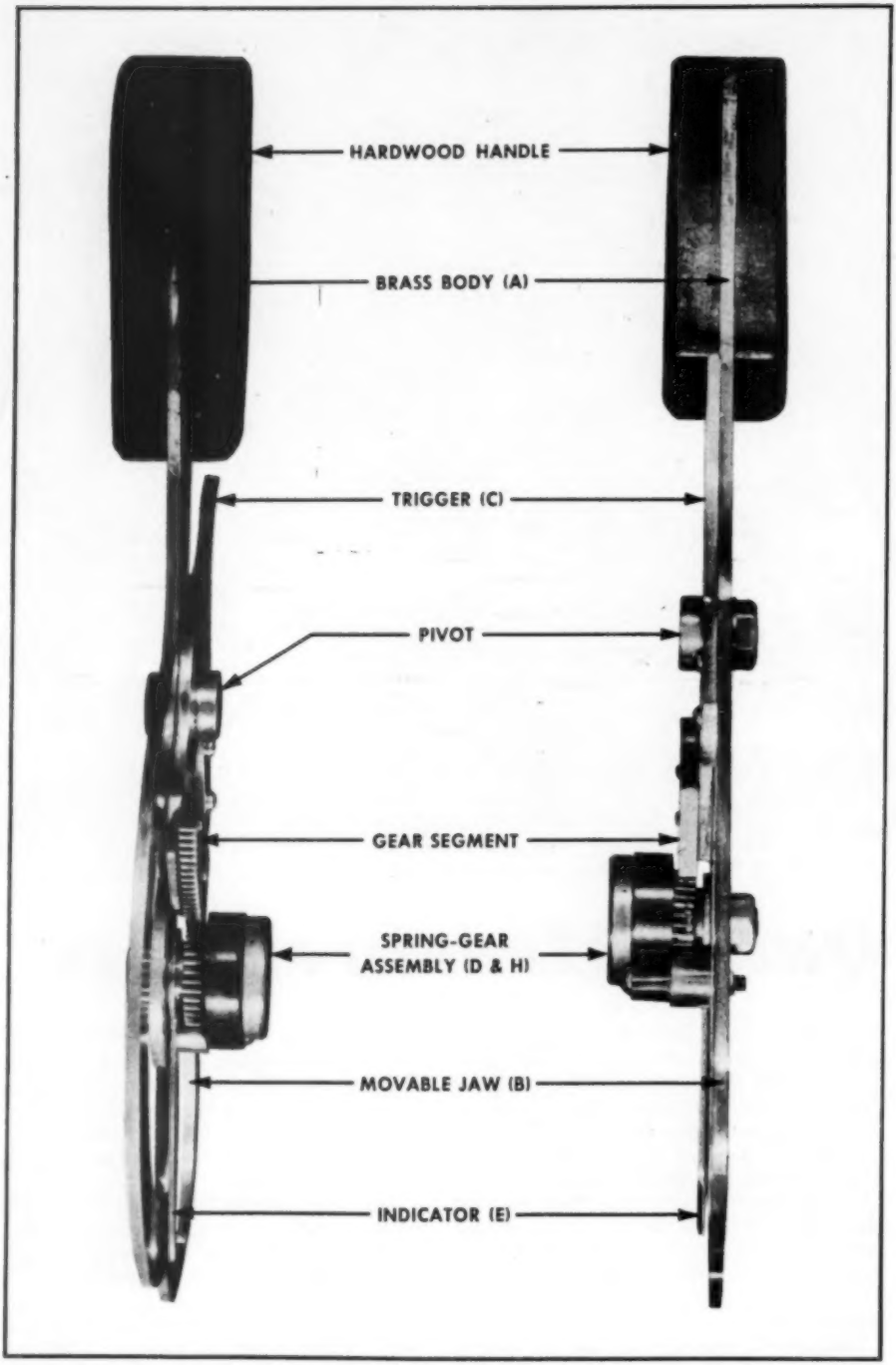
Quick Measurements

a ⅝" gear. The slotted end of the clock spring is secured with a short 2-56 screw for which the hub is tapped. The other end hooks around a 2-56 screw in part *A*, spacer *F* raising it to the gear hub.

Drill and tap the jaws of both caliper legs to receive two shouldered bits of 3/16" drill rod threaded 2-56. Turn these up tight and solder; then file them flush all around with the jaws. Fasten two pieces of hardwood to the handle end of *A* with flush rivets and shape them to it. Polish the brass with fine steel wool and shellac the handle.

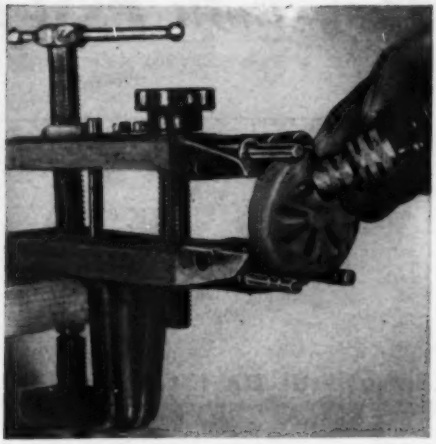
Mount the movable leg on the turned stud *G* and lock with a nut beneath. Put the small gear with its spring and pointer on stud *D*, meshing with the segment so that the jaw tips touch before the pointer contacts collar *F*. Hook the spring on with just enough tension to bring the tips together decisively. Edge-on views on page 194 show assembly.

You can calibrate the scale by placing pieces of drill rod or other accurately sized stock between the jaws and scribing deeply right along the bevel of the pointer. Use a scale to divide the intervals so obtained into thirty-seconds. Another method is to hold slide calipers locked at steps of 1/32" between the jaw tips to scribe the scale.



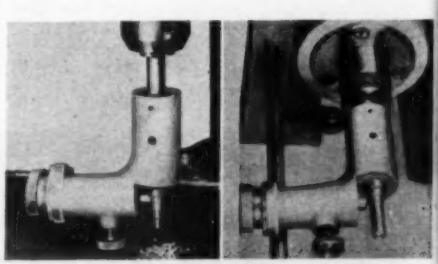
Edge-on views from opposite sides show calipers assembly. Note spacer under the spring end.

Magnet Aids Welder. A magnetic dispenser for use with arc-welding starter powder is made by the Electrical Engineering Company, of Indianapolis. It consists of a weighted base enclosing an alnico magnet, with a conical depression in the top. Placed in the depression, the powder becomes magnetically charged. When a welding rod is dipped in it, enough powder attaches itself to the tip of the electrode to start an arc. The powder (PSM, April '47, p. 197) helps strike arcs at low amperages.



Vise Grips Odd Shapes. In addition to clamping work in the usual way, a bench vise offered by Benjamin Uydess & Sons, Inc., of New York, includes removable steel fingers that make it possible to grip disks, balls, hemispheres, and irregular shapes of almost any kind in convenient working position. Priced at approximately $15, the vise also comes with a ring-arbor attachment that slips over one of the steel fingers. Tubular work is clamped then between the arbor and a second steel finger.

Sander Is Versatile. A pivoted framework that locks in any position from vertical to horizontal adapts a belt sander made by Grover Products, of Los Angeles, to a variety of jobs. Tension of the standard 1″ by 42″ belt is easily adjusted with a wingnut. Ball bearings provide smooth operation. The sander sells for about $19.

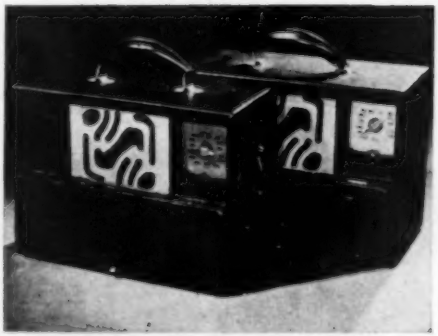


Attachment Turns Metal. With this new attachment, a drill press, wood lathe, grinder, or even a polishing head may be used to turn or cut bar-stock steel, bronze, or aluminum. Priced at about $12, it consists of an L-shaped unit with a built-in micrometer feed and locking screw, two guide bushings ⅜″ and ¼″ in diameter, and one bit each for steel, bronze, and aluminum. For wood lathes and grinders, the manufacturer, the Millholland Screw Products Corporation, of Indianapolis, also offers a faceplate chuck for an additional $4.50. The bits are self-positioning when they are locked in the micrometer tool slide.

They Built PSM Projects

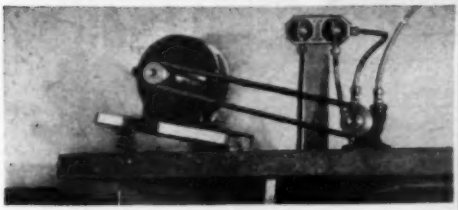
Jeeps Still Have Glamor. For their young owners, there's plenty of excitement left in these pedal-powered composites of the two plans offered PSM readers in Dec. '45. Above, a version of "Bizerte Gertie," made by G. E. Nicholls, of Wanganui, New Zealand, who had to use such Australasian wood as jarrah and rimu. Vernon Jahr, Bemidji, Minn., combined some of Gertie's features with those of the wooden jeep, and his wagon is shown at the upper right. For his first handicraft project, E. Kirchener, of Cleveland, built the model at right.

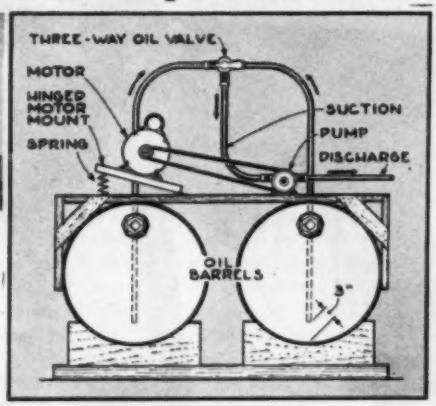
Bell Ringer Plays Music. When William DeWolf, of San Francisco, built his bell-ringer tower (PSM, Dec. '45) he put two phonograph motors to good use. Instead of the ringing mechanism originally described, he uses one motor with an off-center pivot to pull the bell cord. The second motor plays Christmas recordings into the bell tower. Another adaptation consists of a cross studded with flashlight bulbs.



It's Good Enough for Two. At least that's what John Serina, New York, thought when he completed one of the three-way PSM portables pictured above, so he built a second one as a gift for one of the set's many admirers. The cases are entirely of Mr. Serina's design, being different in most respects from the original two-part cabinet described. Outer covering is of leatherette, and the half door opens on the dial, controls, and a jigsawed hardwood inlay over the speaker grille.

Fuel Oil Pumped from Cellar to Upstairs Outlet



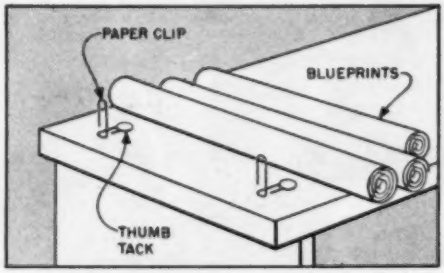


THIS pump unit was rigged up to eliminate the necessity of lugging oil from the cellar every time a kitchen-range tank needed filling. A switch upstairs near the oil outlet turns on the motor.

The pump was obtained from an old furnace oil burner and the ¼-hp. motor from a washing machine. By mounting the motor on a hinged base, its own weight was utilized to help keep the V-belt tight. A coil spring under the raised end of the mount takes excess strain off the belt.

The 5/16" tubing from each barrel was led to a three-way oil valve. Ours consists of two gas-stove valves attached to the pump suction line. This makes it possible to switch from one barrel to the other, and refill the empty one.—A. J. SEYMOUR, JR.

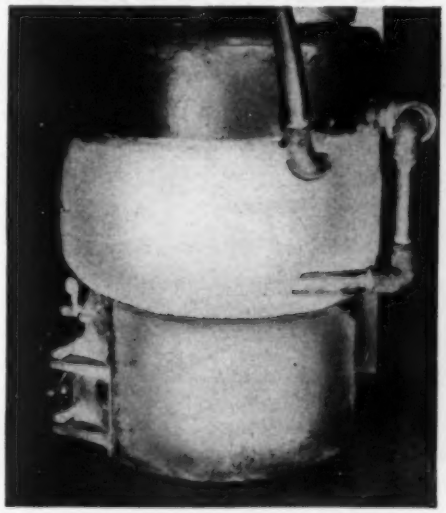
Clips Hold Rolled Blueprints



BLUEPRINTS that have been rolled up may be prevented from rolling off the end of a table by two or more stops fashioned from paper clips.

Bend the clips to form an angle and then secure them to the table with thumbtacks. With these in place, several rolls can be conveniently stacked in no danger of sliding off the table.—W. B. EAGAN.

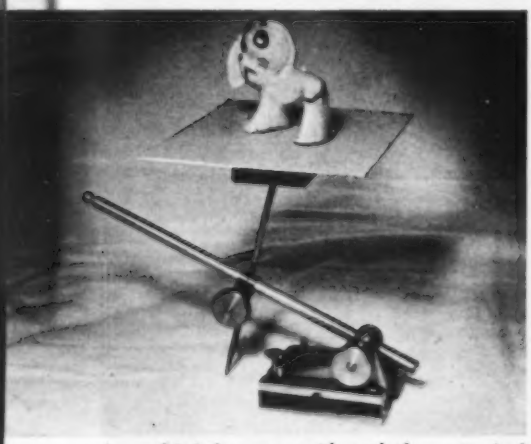
Heater Made More Efficient



IF YOUR pot stove is the type that has a water jacket only around the dome, its efficiency can be virtually doubled by winding a continuous length of copper tubing around the firepot and connecting the coil into the household hot water system.

Tubing from ⅜" to ¾" can be used. You will need from 20′ to 35′, depending on the stove size and the number of turns you want. Pipe-thread adaptors will provide the connections to the hot and cold water pipes. You will also need two sweat-fitted elbows. In making the connections, remember that the bottom of the coil should connect to the cold return and the upper to the hot-water lead. Fasten wire screening over the coil and on this trowel a ½" layer of asbestos cement as insulation to conserve heat.—JOHN MRACEK.

With this simple setup, you can photograph small objects at many times their original size.



A machinist's gauge with a platform attached provides a flexible stage for your subjects.

Only ¼″ long, this pin was increased in size by photographing it through a tube 1″ long.

Lens Tubes Shoot 'Em Big

Bigger-than-life blow-ups are a cinch with these homemade lens tubes. They'll work on almost any camera.

By Charles Smith

PICTURES that show small objects bigger than life size can be taken with almost any camera, provided it has a removable lens. The trick, of course, is to use a lens extension tube. Don't fret if you do not have facilities to machine metal tubes; cardboard tubes do nicely if fitted with care.

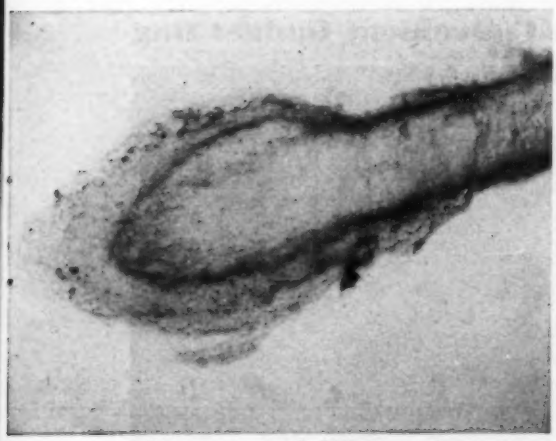
Take the lens out of your camera (if you have a between-the-lens shutter, remove the whole unit), and fit a short tube in the hole in the lens mount. If you can't locate a tube of the right diameter, build up one that's a loose fit, using strips of glued paper. It's well to make several tubes of different lengths at the same time—ones 1″, 2″, and 3″ long will do as a starter. The lens should be fitted to the outer ends of the tubes, again using glued paper rings if necessary. Coat the inside of each tube with flat black paint, and be sure the tube screws squarely into the camera and the lens screws squarely into the tube.

If your camera has a ground glass, you're now set to try a few shots. If not, the proper focus for each tube must be determined first. Remove the back of the camera and tape a piece of ground glass or tracing paper in the plane the film occupies. With the shutter open, move an object back and forth in front of the lens until you find the sharpest focus. A piece of graph paper is handy for the purpose since it also shows the exact area that can be photographed with a particular tube. Block off on the paper the field that each tube covers. This provides a ready guide as to which tube must be used to cover any object photographed.

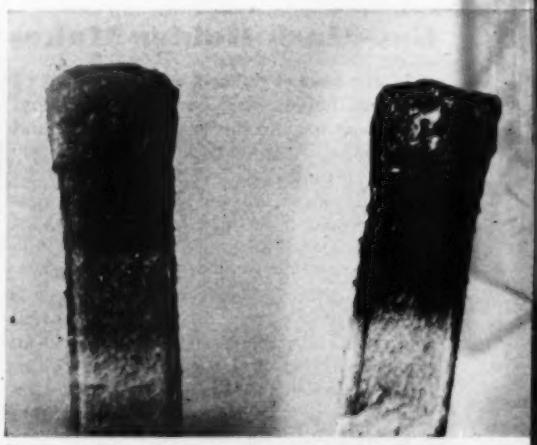
After the test object has been brought into sharp focus on the temporary ground glass with the lens wide open, carefully measure the distance from the lens to the object. Make a notation of this, along with the size of the area covered.

Because the distance from the lens to film has been increased, it will also be necessary to compute—and keep a record of—an exposure factor for each tube. This factor may be determined by measuring the distance from the lens to film, squaring this distance, and dividing by the square of the focal length of the lens. This yields the number of times you must multiply the exposure that would be normal for any given lighting condition without the tube.

If at all possible, use a tripod to support



A hair root magnified 50 times. A microscope objective was used as the lens in this case.



Two match heads present this appearance when pictured through a tube. One has been burned.

Placed on a black background, these rice grains were photographed through a tube 1" long.

the camera, and if the tube tends to sag, install a prop to keep it at right angles to the camera. Exposures should be made with a cable release, for any vibration will spoil the picture. If you have no cable release, shut off the room lights, open the shutter, and use the light switch for exposures.

Any illumination may be used, but I find a gooseneck lamp very convenient. For contrasty spotlighting, I also sometimes use a slide projector. Masks for spotlighting small objects may be made by placing coins or other objects on a sheet of process film and then flashing with light. After being developed, the film can be cut and fitted in the projector as you would a slide.

Rather than disturb the camera after it has been set up, you may find it more convenient to focus by moving your object toward and away from the lens. For this, a machinist's surface gauge may be adapted to provide a handy stage on which to pose the object to be photographed. Stick a small block of wood on one of the prongs and glue a square of cardboard to the wood. This little stage may then be tilted to any angle, raised, lowered, and the entire unit may be moved to bring the object into focus.

Exposures are no problem if you use a meter and take into consideration the exposure factor determined for the tube. If you do not have a meter, a few tests will indicate the proper exposure for any particular condition. In any case, it is advisable to go down to the smallest possible stop on your diaphragm because in this work the depth of focus is very slight.

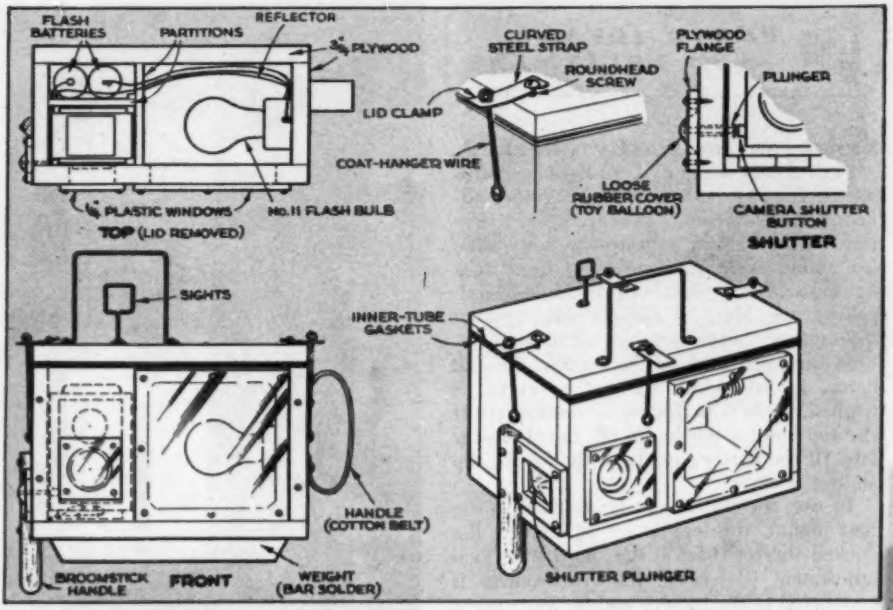
Occasionally you may get bright streaks across photographs of shiny objects. These may be avoided by adjusting your illumination so that light is not reflected directly into the lens. END

Gas-Mask Holder Makes a Convenient Gadget Bag

LIGHT in weight and water-resistant, a gas-mask holder may be easily converted into a bag for carrying a small camera and accessories. Its size makes it particularly suitable for a 2¼" by 3¼" Speed Graphic.

In this case, a pocket of waterproof canvas was made to fit the camera snugly. This was then sewn into the bag with ¾" sponge rubber as lining on four sides and the bottom, protecting the camera from dampness and from bumps or falls. A second pocket was installed to keep six film holders in an upright position, and a third accommodates filters, a lens hood, and other small accessories.

Overlapping flaps secured by snaps protect the contents. A shoulder strap makes the bag easy to carry.—JOHN TRIMBLE.



Safe inside a watertight box, the camera and flash are tripped by a rubber-sealed plunger.

Dive for Your Photos

SNAPSHOTS under water are easy, inexpensive, and fun. This outfit was built on a South Pacific island and used among the coral reefs in those wonderfully clear waters. You can borrow the idea for future use at your favorite swimming hole.

The equipment consists of a sturdy, watertight box of ¾" outdoor plywood holding an inexpensive fixed-focus camera with synchronized flash. Melted tar was used on the joints and around the clear-plastic windows, and the lid was fitted with a gasket cut from an old inner tube and bedded in tar. The shutter was tripped by pressing a plunger through a loose rubber diaphragm. Bar solder was attached to the bottom to neutralize almost all buoyancy. A partition in the box eliminates internal reflections.

Test the box thoroughly for watertightness, and then, armed with diving goggles, you'll be ready for a new kind of photography.—CHARLES E. DUNNING.

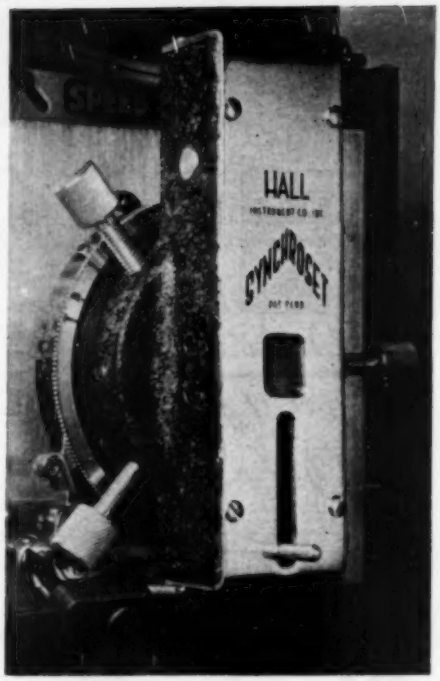
A swimmer poses for an underwater portrait. For such shots, a fixed-focus camera is best.

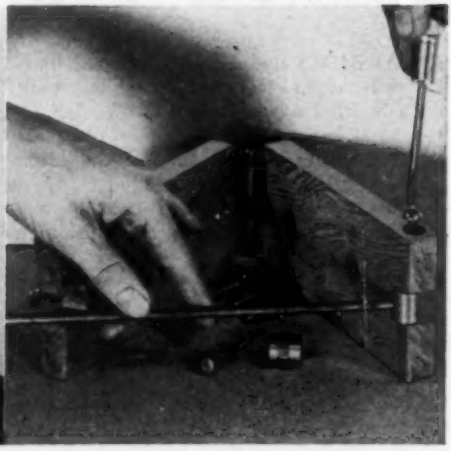
A small fish swims by. Fast film and a No. 11 bulb are quite effective up to 8′ in clear water.

PHOTO IDEAS AND EQUIPMENT

Synchronizer Easily Checked. An instrument made by Hall-Barkan Instruments, Inc., of Tuckahoe, N. Y., guides adjustment of solenoid synchronizers. The primary mechanism is an up-and-down slide containing a slit that moves in front of a lighted screen of equal width bands of red, yellow, and blue. If the operator, looking through the instrument toward a lamp behind the open back of the camera, sees all bands in full width when the shutter is tripped, there is perfect synchronization. If the top band is partly cut off, the shutter is late. If the bottom one is partly cut off, the shutter is early.

In use, the instrument is attached to the lens mount, the lens is set at infinity, the cocked shutter is set at the speed for which adjustment is desired, the synchronizer is connected to the battery and the instrument to the remote control outlet, and a cocking lever on the instrument is raised.

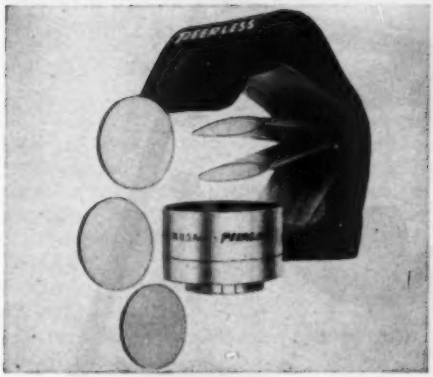




Head Tilts to 90 Deg. Locked by turning a setscrew against a 12″ sliding rod, this tripod head tilts on a 3″ butt hinge that is mounted to leave 1″ space between the two ¾″ by 3½″ by 6″ wood members.

Slots 1″ deep are centered in one end of the top and base for collars made from ¾″ lengths of ¾″ brass rod, and ¼″ holes are drilled edgewise across each piece for ¼″ stove bolts on which the collars pivot. Drilled lengthwise, the collars are tapped for the stove bolts. One is drilled and tapped half through for the threaded end of the slide rod. The other is drilled so the rod may slide, then turned 90 deg., and drilled and tapped for the setscrew.

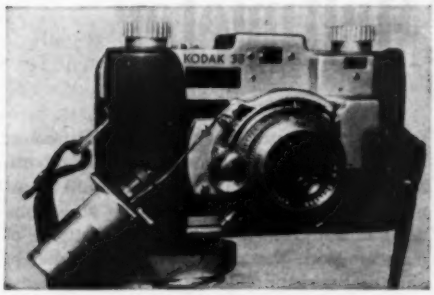
After ¼″ holes are drilled, ¼″ nuts are hammered flush against the inner face of the top and base for 1″ wing bolts to attach the head and camera.—Sam C. Donaldson.



Wallet Holds Filters. The plastic compartments of this wallet were designed to permit quick removal or insertion of filters without getting finger marks on them. Made of leather, it was introduced by Peerless Camera Stores, Inc., of New York, as part of a movie filter kit. The kit also includes a combination lens shade and holder.

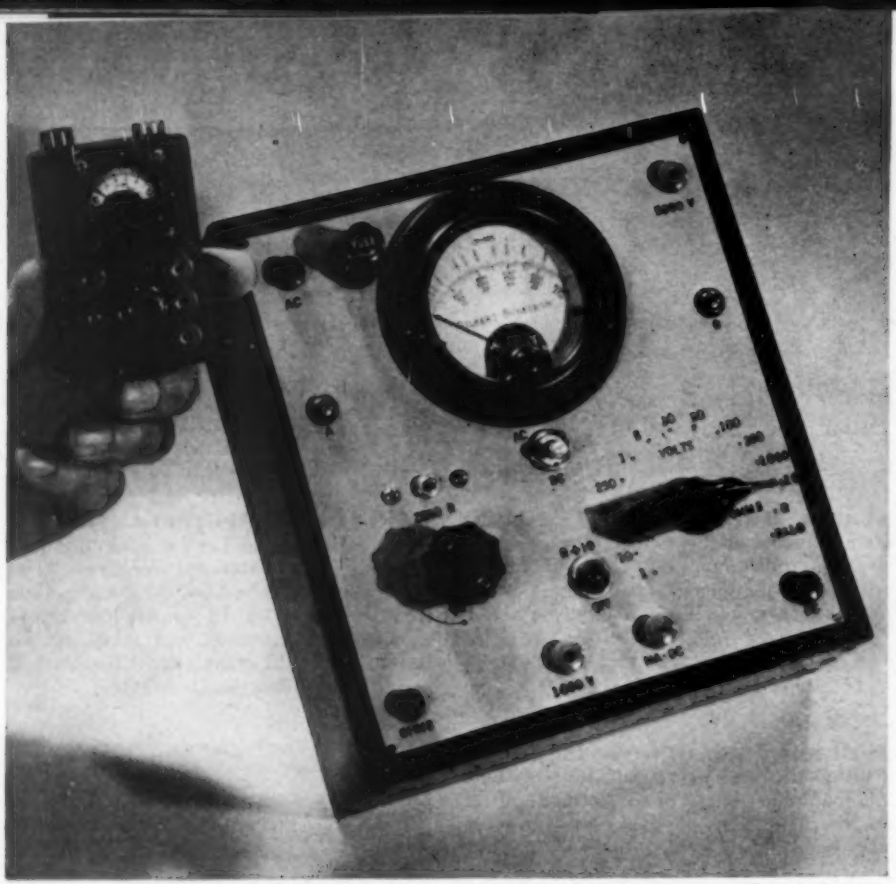
Container Protects Brush. Mounted in an old lipstick case, this lens brush is always protected from dust. The outfit may be made by cutting the handle from a No. 10 or 12 camel's-hair brush, cleaning out the case, and attaching the brush with liquid solder. Let it harden well before using.—Eric Karminski, Jr.

Balance Pans Improvised. Even with good care, balance pans supplied with photographic scales often become pitted. As indicated in the photo at right, you probably have several good substitutes at hand. Two plastic saucers, filed until their weights are identical, are one possibility. Waxed cups are another.—David H. Thompson.



Timer Snaps You Too. If your camera is not equipped with one of the delayed-action devices that enables you to get into the picture, the situation may be remedied with one of the flight timers sold at model-airplane stores. Form a loop in one end of a piece of stiff wire and hook it over the shutter-release lever. Loop the other end around the plunger of the timer so that it will trip the shutter.—F. G. Knight.

Blower Dries Roll Film. A small blower, a 75-watt lamp, two cans, and a few scraps of tin are used in this dryer. Located in the taller can, the lamp is wired in series with the 24-volt blower, thus both dropping the voltage and supplying some heat. An opening cut in the side of the film can admits warm air through a connecting tunnel, and an opposite hole discharges it. The can top is used.—R. B. Goodell.



Bench instrument or pocket-size midget, a multitester is a must in every electrical shop.

Completing Your Multimeter

If you built the tester described last month, you will want these further pointers on its use.

By Gilbert Sonbergh

PART THREE

SINCE all the essential information needed for building three types of multimeter was given in the two previous issues, you probably have your tester pretty well under construction. The two smaller units illustrated last month present no special problems. Most of this discussion, therefore, concerns the featured instrument.

It was stated that the range of a series ohmmeter cannot readily be lowered enough to measure very small resistances. To do that a shunt ohmmeter was recommended. The principle of the shunt ohmmeter will be recognized as the same one used to determine the internal resistance of a meter with the aid of a known value of shunting resistor (Oct., p. 204). If we use a 0 to 1-ma. meter with internal resistance of 105 ohms, and shunt it with an equal resistor while energizing the circuit, a half-scale reading of 105 ohms results. Unlike series-ohms readings, infinite resistance is at full scale and zero is at zero on the dial.

A reading of 105 ohms center scale (higher if a fuse is used in the circuit) is not, however, sufficiently lower than the 450-ohm range to be of great value. In our

circuit, therefore, the meter and fuse are shunted to read 10 ma. in order to provide a center-scale reading of 11.4 ohms. Switch positions are the same as for the lowest series-ohms range, but a test lead is used to short the DC and OHMS terminals. The unknown resistor is then inserted between this jumper and MA-DC. Since accuracy is dependent primarily upon current value, rheostat R16 is turned to "off" position, and current is regulated to full scale—precisely 10 ma.—by R17. This is being done by the screwdriver adjustment illustrated at the upper right.

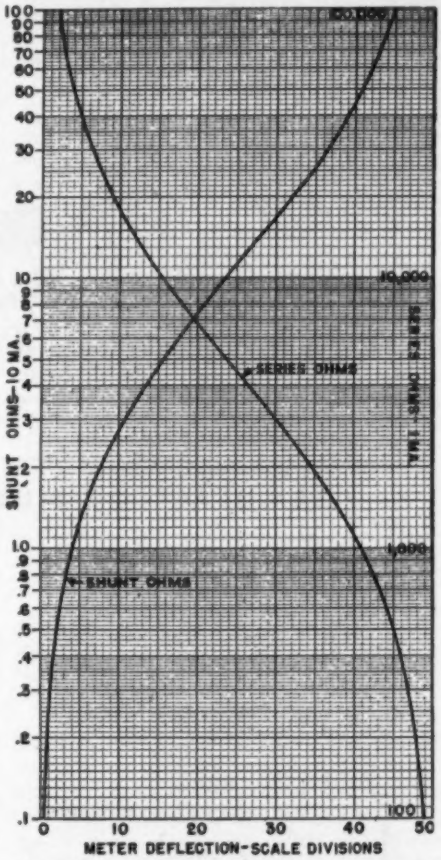
The resistor under test then shunts the whole circuit, and its value may be calculated from formula 8 (Oct., p. 204). It must be remembered that this formula is only an approximation, and its accuracy decreases as the circuit current is raised. The graph at the right was plotted by calculating a number of points from a more exact formula, and it should hold reasonably well for any meter constructed with the same values as the one shown.

If the graph should prove inaccurate for your meter, you can plot another one with the help of a few feet of resistance or fine-copper wire. Measure a dozen or so lengths of wire and calculate the resistance of each from the ohms-per-foot rating of the wire. Then check the wire on the meter and plot scale deflection against known ohmic value. Shunt ohms are represented by the numbers in the left hand margin of the graph; a companion curve for a series ohmmeter crosses it from upper left to lower right and is read against the figures in the right-hand column. The chart is drawn on logarithmically scaled paper, available at most stationers.

As has been pointed out, the reason that ohmmeters are peaked at center scale is that all ranges cover the area from zero to infinity, and therefore both ends of the scale are bound to be inaccurate. The problem of measuring low resistances may be met by the shunt ohmmeter. But what about very high ohmic values? Of what use is a meter that reads, say, 90,000 ohms when you want to measure a resistance of several megohms? The answer seems to be that you can't make these measurements, but in fact the problem is easily solved. All you need is a voltmeter and a source of high voltage, such as the power-supply circuit of an AC receiver.

Measure this voltage—preferably several hundred volts—and then make a second

Adjusting the meter to read on the lowest ohm range. Scale divisions are graphed as below.



A graph of this type will help you interpret nonlinear shunt and series ohmmeter readings. It should hold for meters built like the one above, or it can be plotted from known values.

reading with the unknown resistor in series with the meter. The unknown value may then be calculated from formula 9, below.

Your AC voltmeter may also be used to measure capacitance, inductance, and impedance with sufficient accuracy for most purposes. An AC power line will serve very well, provided that you take adequate precautions to prevent electrocution. First measure the line voltage; then take a second reading with the unknown element in series with the voltmeter.

Capacitance of condensers is figured from formula 10. Again it may be wise—if any considerable number of readings is to be made—to draw a logarithmic graph in which the voltage readings of your meter are plotted against capacitance. The graph will be useful wherever the same meter is used on the same line voltage. Use a dozen or so accurately known condensers to plot this graph. Capacitance measurements may be multiplied by ten or a hundred if the voltmeter leads are shunted by suitable resistors to reduce the effective voltmeter resistance (Rv in the formula) to a tenth or a hundredth of its normal value. Alternatively the high ranges may be obtained by using a stepdown transformer (and a lower voltmeter range) to reduce the values of Em and El.

Inductance is calculated approximately from formula 11. A graph of inductance values against meter readings would be accurate only for high "Q" inductances—those in which DC resistance is small compared to AC inductive reactance.

Impedance is expressed in ohms, and is the tendency of capacitors or inductors to resist the flow of alternating current of any given frequency. When needed, the impedance of a coil or condenser may be obtained with the help of formula 12.

An AC rectifier-type voltmeter makes an excellent output meter for receiver alignment, power-output measurements, measurements of gains or losses of amplifiers, and the like; it may be calibrated in volts or decibels. If any direct current is present in the circuit under test, it should be kept from the meter by a good quality paper condenser of from .5 to 2 mfd. The AC component or "ripple voltage" of power supplies is measured in this manner.

If your meter is built according to all the specifications given in the previous installment, the face of the instrument, including switches and test jacks, will probably resemble that of the larger unit shown on page 204. To read DC milliamperes, then, insert test leads into the DC and MA-DC pin jacks. Note that a narrow pin and adapter is shown in the photos for the latter jack. This is used to lessen the possibility of applying a high voltage to the milliammeter by accident. When making current measurements, always start out with the selector switch indexed to the highest range and back down until an accurate reading can be made. Insertion of a milliammeter into a circuit that

FORMULAS FOR MULTIMETERS [ELECTRICITY]

To Use Voltmeter as Ohmmeter

(9) $R = \frac{E_b R_s}{E_m} - R_s$

where **Rs** is total fixed resistance in meter circuit.
Eb is battery or power-supply voltage.
Em is reduced voltage reading during test.

AC Voltmeter as Capacitance Meter

(10) $C = \frac{Em}{2\pi f \; Rv \sqrt{E_l^2 - E_m^2}}$

C is unknown capacitance (in microfarads).
El is full voltage of AC line.
f is AC frequency ($2\pi f = 377$ on 60 cycles).
Rv is total voltmeter resistance (in megohms).

AC Voltmeter as Inductance Meter

(11) $L = \frac{Rv \sqrt{E_l^2 - E_m^2}}{2\pi f \; Em}$

L is unknown inductance in henrys.
Rv is total voltmeter resistance in ohms.

AC Voltmeter as Impedance Meter

(12) $Z = \frac{Rv \sqrt{E_l^2 - E_m^2}}{Em}$

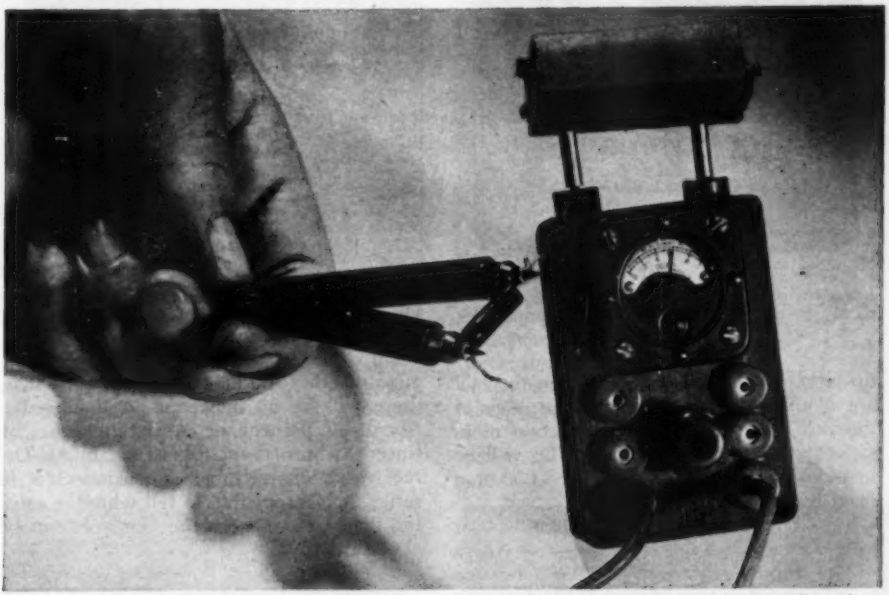
Z is unknown impedance in ohms (may be capacitive or inductive).

POPULAR SCIENCE MONTHLY SHOP DATA

has low resistance and high current will cause a change in the normal current flow. Such measurements should therefore be made on the highest range that will still provide a readable pointer deflection. For greatest accuracy on DC current and voltage ranges, turn R16 to its "off" position in order to keep the 10,000-ohm rheostat from shunting the meter.

Voltages are read by inserting the test leads into the DC (or AC) and 1,000-volt jacks. The AC-DC switch is also thrown to correspond to the character of the voltage being measured. Index the selector to the appropriate range. When measuring voltages in excess of 1,000, move the test lead from the 1,000 to the 5,000-volt jack, and leave the selector on 1,000. Exercise caution when measuring high voltages. One good practice is to keep one hand in your pocket and perform all necessary manipulations with the other. END

Midget Volt - Ohmmeter

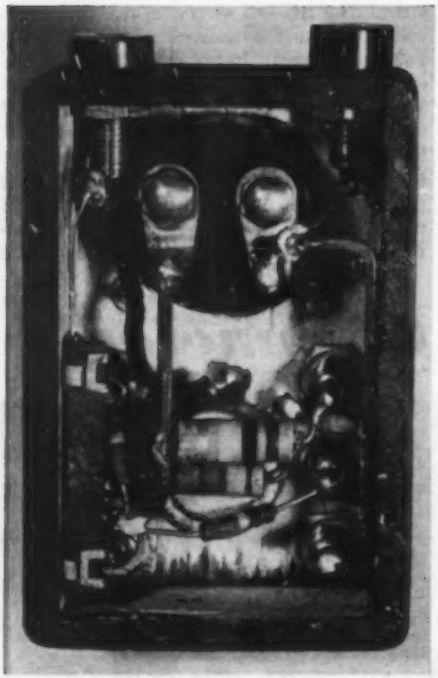


With external battery the pocket-size tester measures two ranges of resistance. Three penlight cells in series, wrapped in cardboard or cellulose tape, make a compact voltage source.

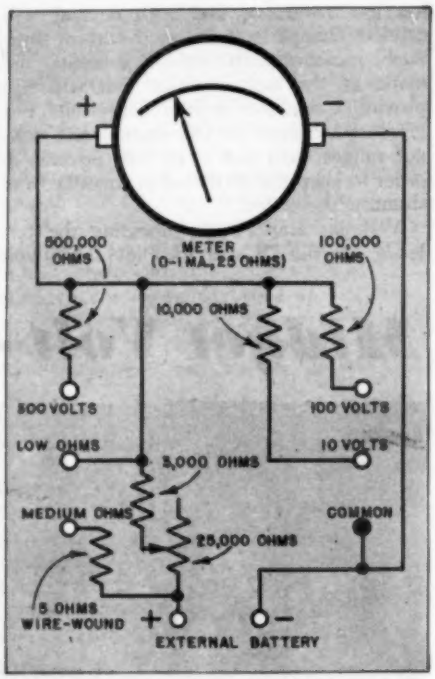
WHETHER or not you have built, bought, or borrowed a general-purpose multitester, you will find a place in your electronic tool kit for a midget meter that measures the things you most frequently need to know. If you are a beginner, building it will teach you the principles and uses of multitesters; if you are an experimenter or service man you will find unlimited applications for an auxiliary, pocket-sized instrument both in and out of the shop.

Compact as the meter is, all the components are standard. When buying the resistors or selecting them from your spare-parts box, you will want to check them for accuracy on a reliable ohmmeter. All resistors are connected in series with the positive side of the midget meter.

The meter itself, a 0 to 1-ma. unit with internal resistance of approximately 25 ohms, is of the type developed during the war for use in aircraft equipment. It measures only 1″ in diameter and has a mounting flange 1⅜″ square. Together with all the auxiliary parts, it is built into a 1″ by 2″ by 3″ wooden box. Near the top of the box panel, drill a hole slightly over 1″ in diameter. Aside from the meter, six phone-



Even inside the 1" by 2" by 3" case, there is plenty of room for the handful of components.



In most respects placement of the parts can follow the layout shown in the diagram above.

tip jacks and a midget 25,000-ohm rheostat are mounted on the face. In the edge of the box above the meter place two more jacks for the external battery. This will be in series with the rheostat and a 3,000-ohm fixed resistor.

For both the low and medium-ohms ranges an external battery is required. Use a 4½-volt supply; three pen-light cells in series are suggested because they will not add very much to the size and weight of the equipment.

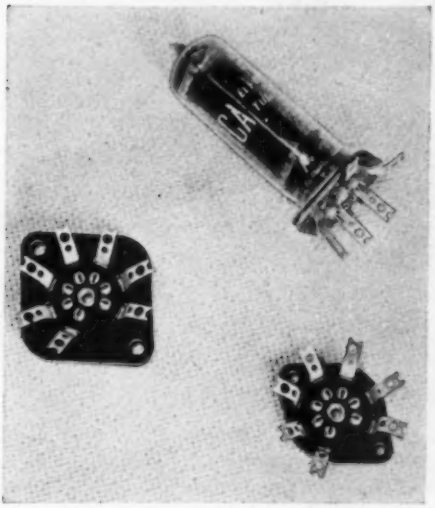
The five scales chosen offer a wide variety of uses in radio servicing. The 0 to 10 and 0 to 100-volt ranges will enable you to check all sizes of A and B batteries, and the 0 to 500-volt scale will come in handy when you want to know the potential across the plate or screen of most receiver tubes.

Each of the ohms ranges has its own particular advantage. All antenna, RF, and IF coil windings, as well as filter chokes and power transformers, can be tested on the low scale, and this range is also useful as a continuity tester. By touching the two prods to the heater pins on a tube, you can determine whether the filament is open. If it is, there will be no deflection of the needle. About 80 percent of set failures can be traced to burned-out tubes, and in AC-DC receivers, where tubes are connected in series, it is impossible to tell which is causing the trouble unless the filaments can be checked.

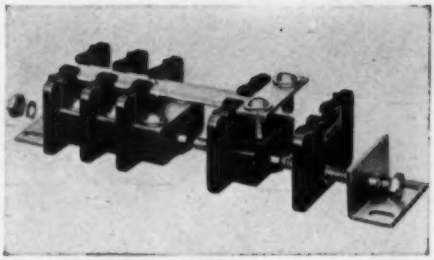
With the medium-ohm meter you can tell whether the high-resistance windings of such parts as high-impedance chokes, output and audio transformers are open or shorted. Higher resistors, such as may be found in plate, screen, or coupling circuits, can't be measured directly, but defects can easily be spotted by checking the voltage reaching the tubes. Both ohms scales can be used to detect shorts in paper-tubular condensers and leakage in electrolytics.

You can read volts directly by multiplying scale markings by 10, 100, or 500, depending upon range. The ohmmeter is for service checking rather than for accurate measurement. To get approximate values, measure a dozen known resistors and graph pointer positions.—ALBERT ROWLEY.

NEWS IN ELECTRONICS

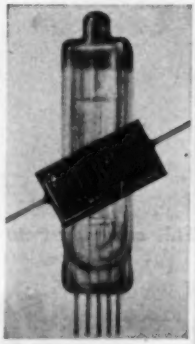


Sockets Grip Miniature Tubes. The wire prongs of miniature tubes frequently slide out of their sockets or make intermittent contact. A remedy is offered by A. W. Franklin Mfg. Corp., New York, in the sockets shown above. Metal eyelets converge around the pins to assure positive, constant contact.



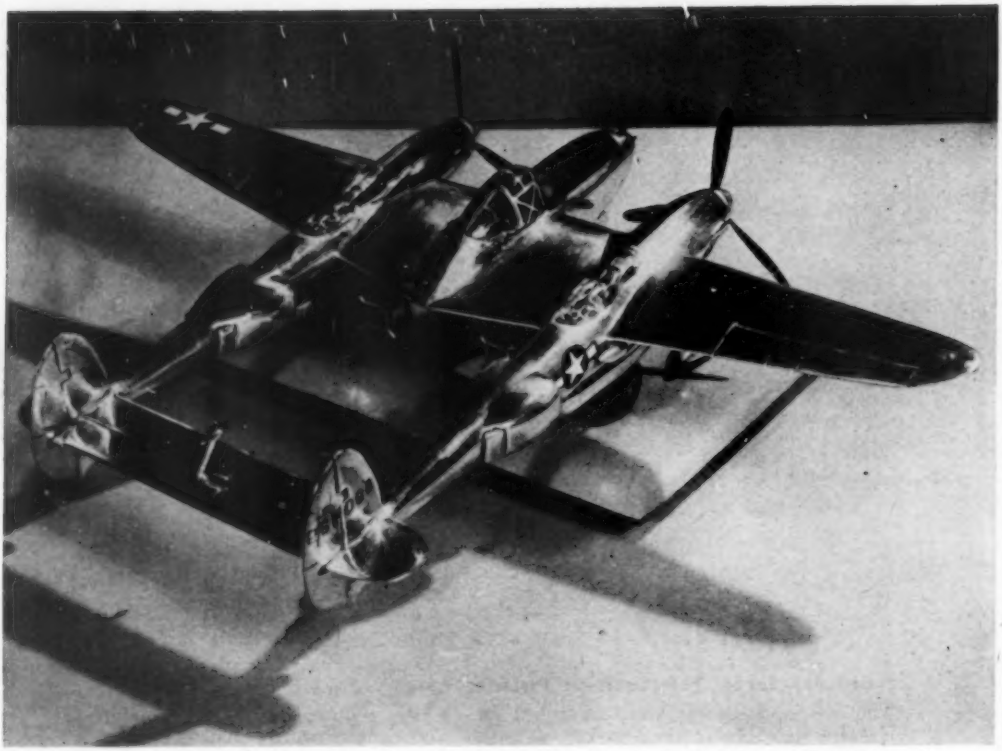
Add Terminals as Needed. Experimenters can give hand-made equipment a more finished look and make wiring easier by building up terminal blocks from kits produced by the Curtis Development & Manufacturing Company, Milwaukee. From one to 14 terminals can be assembled in one strip from the parts furnished in the kit.

Parts Shrink. Subminiature tubes are now matched in size by midget capacitors manufactured by Tobe Deutschmann Corporation, Canton, Mass. The paper-dielectric condensers are molded in wafer-shaped phenolic cases to suit the closely stacked assembly of miniature apparatus.



Device Calibrates Voltage. When connected to any oscilloscope, this new Du Mont instrument provides a convenient method for measuring peak-to-peak value of any signal. It generates a square wave which is continuously variable from 0 to 100 volts and which may be directly compared with any signal being viewed.

Phono Runs on Spring or AC. One drawback to the production of AC-DC-battery phonograph portables has been the lack of motors that would operate anywhere. Capitol Records, Inc., of Hollywood, combines an AC motor and a spring-drive mechanism with a three-way amplifier to get a truly portable record player.



This gleaming P-38 was produced by silverplating a conventionally built balsawood model.

How to Silverplate

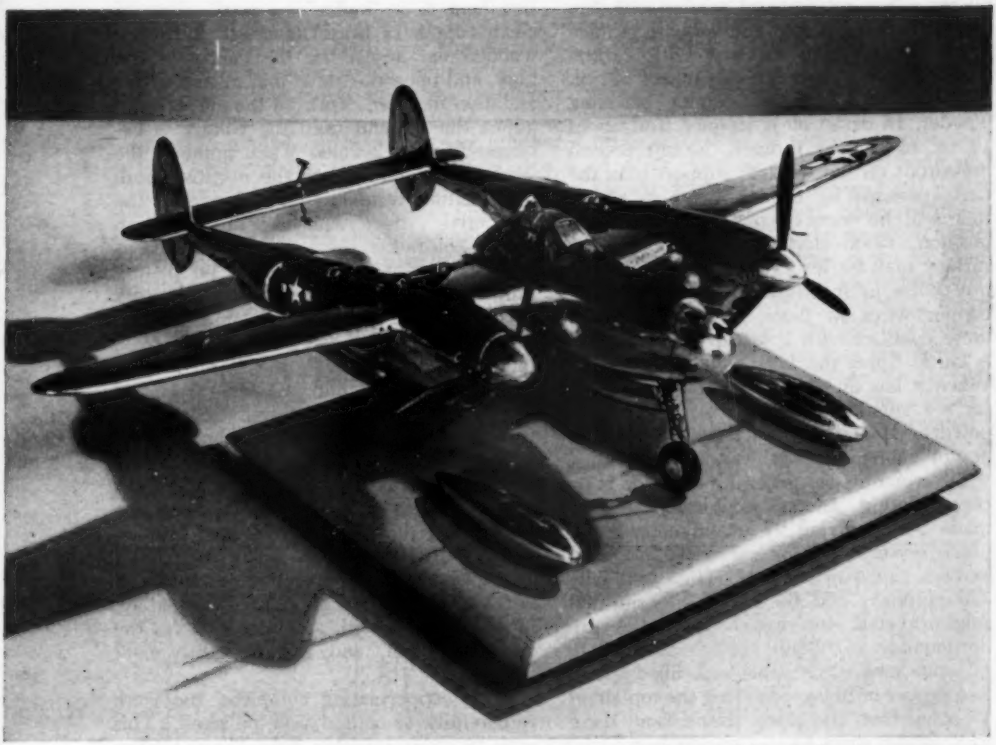
By Whiting Evans

PROJECTS executed in wood, plaster, plastics, or ceramics can be permanently encased in a resplendent metallic sheath that will greatly enhance their beauty.

You'll need a plating tank big enough to handle your work. Calculate tank size by allowing at least 6″ from the object to be plated to the anodes, and at least 1″ from the anodes to the tank sides. But don't go overboard on tank size unless you're prepared to mix up solutions in big quantities. (My P-38 model shown would have required a 30-gal. tank if I had plated it all at once, but by sawing it in half, I did it in a tank measuring 10″ by 15″ by 20″.) If you wish to build your tank, it can be made of wood lined with either sheet lead or sheet rubber. Perhaps you can pick up a glass storage-battery tank or a rectangular goldfish aquarium of suitable size. A big crock of glazed earthenware will also do.

As best results in plating are achieved by constant agitation of the electrolyte, it's desirable to feed air through a perforated pipe on the bottom of the tank. Small holes drilled every 3″ or so in a plugged lead pipe will do the job, or rubber tubing weighted down with wire solder could be used. To keep even a drop of oil from the compressor from contaminating the electrolyte, provide an oil trap on the air-input line. This need only be a soup can packed with clean, dry cotton. If you don't have a compressor, any source of low-pressure, low-volume air will do, even a toy steam engine run backward by a small electric motor.

Plating requires a regulated source of low-voltage DC. You may wish to use a

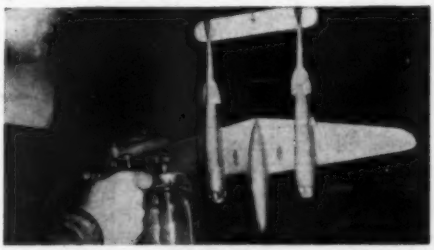


Silverplating is an especially appropriate finish for display models of aluminum aircraft.

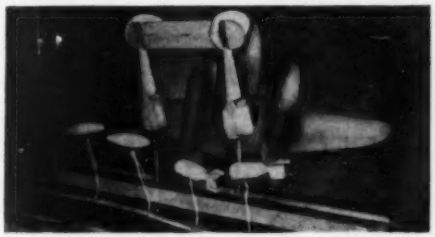
Wood

storage battery and rheostat, a battery charger, or a transformer-rectifier unit of the sort used with modern model trains. Perhaps the most flexible rig is the one illustrated, in which a shop motor drives an old auto generator, with a storage battery "floating" across the line to limit voltage. A fairly good voltmeter is a must, and an ammeter handy but not as important. If you don't have a suitable rheostat, use some nichrome wire of the sort supplied as a replacement element for a toaster or electric iron. One lead is connected to the end of the nichrome wire and the other is clipped on as far along as is necessary to get the right resistance.

Be sure that the finish of your project is as perfect as you can make it. Remember that any flaws in the surface will be more conspicuous in the polished metal plating. The plane model shown was carefully lac-



Powdered metal and lacquer are sprayed on the work so as to make it electrically conductive.



Ready for plating, the cut-apart sections of the model are mounted on stiff copper wire.

quered, filled, relacquered, sanded with No. 400 paper, relacquered, rubbed with pumice and oil, and then cleaned with carbon tetrachloride to remove all traces of oil.

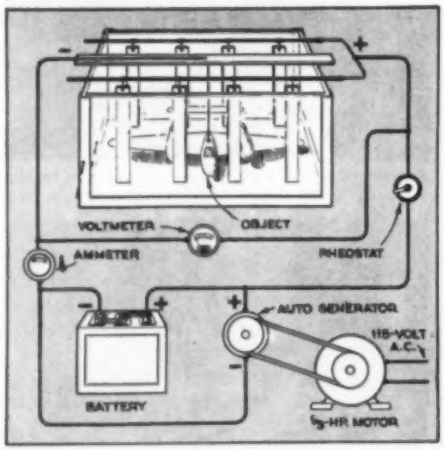
Mix about 2 oz. of copper bronzing powder, 1½ oz. of clear lacquer, and about 13 oz. of lacquer thinner. Mount several brass rods on the work to support it in the tank, perhaps by drilling holes in places that will be inconspicuous in its finished position. Good electrical contact with the surface may be insured by drilling several tiny holes in inconspicuous spots, placing copper wires in them, and touching up these contacts with a brush dipped in the mixture. Spray the work with an even coat. When it has dried, a finger touched to the surface should show some of the copper powder. If none shows, too much lacquer or not enough thinner was used.

Silverplating is generally preceded by copperplating. Electrolyte for the latter is made by dissolving 27 oz. of copper sulphate crystals in sufficient warm water to make a gallon of solution. Then gradually and carefully add 6½ oz. of concentrated sulphuric acid. Increase the quantities proportionately to obtain enough solution to fill your tank. With the tank filled, place two copper or brass rods along the top about 1" away from the sides. Hang from these rods copper strips having an immersed area at least equal to the area of the surface to be plated. These are the anodes, and should be connected to the positive lead from the current source. Connect the negative lead to a "buffer" (a small piece of clean copper or brass), suspend it from a wooden bar across the the center of the tank, and open the valve that allows air for agitation to enter. Turn on the current and adjust the rheostat until the voltage is between .75 and 2 volts. Then immerse the work, also connected to the negative lead.

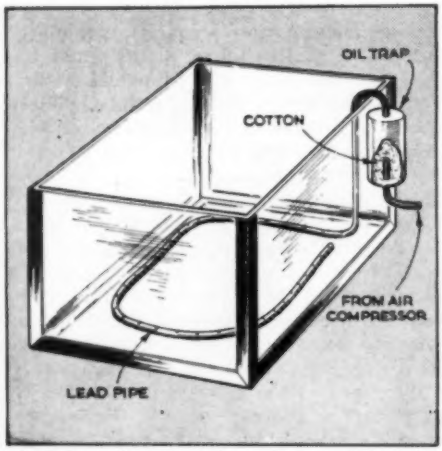
If plating is taking place properly, the lacquered surface will take on a pinkish glow. The buffer sheet can be removed as soon as the object is seen to be plating properly. After 15 min., remove the work and inspect it carefully. Color should be a light shade of pink. If it is a darkish pink, the plate is "burning"; the burned areas must be removed and the work recoated with the conductive coating. Reduce the voltage and begin again. If the color is right, continue plating until about 1/32" of metal has been deposited. (Thickness can be measured by caliper comparison.)

If during plating little hydrogen bubbles form on the work, wipe them off and increase the amount of air. Should they form unnoticed and leave pockets in the plating, fill the pockets with soft solder, dress the surface smooth, and replate lightly over the solder.

With copperplating complete, the work is carefully smoothed and polished. This may be done by *very* light filing, buffing with cloth wheels charged with buffing compound, and finally polishing with a clean cloth wheel. Be extremely careful not to go through the thin copper sheath.



Here's the plating circuit. Disconnect the battery when the generator is not being driven.



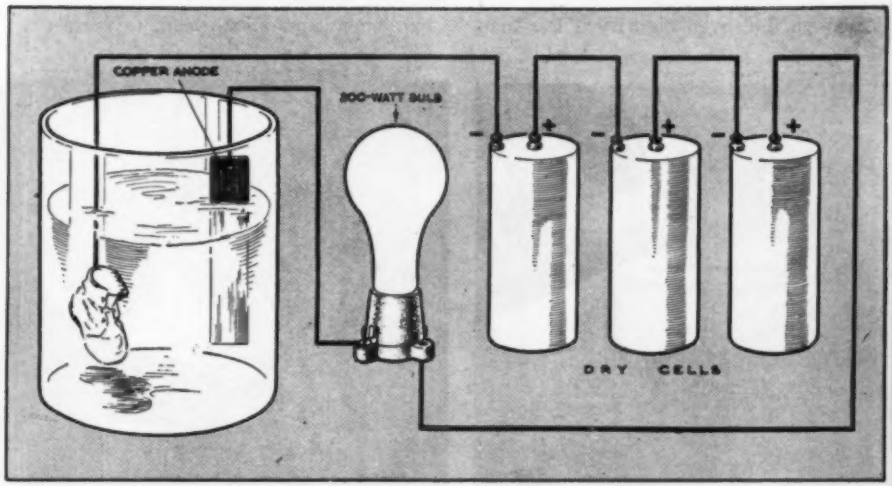
Agitating the electrolyte with air bubbles is important to getting an even plating deposit.

If this happens, it's possible to solder a piece of thin shim brass over the damage, file it smooth, and replate lightly.

Before silverplating, clean the tank with extreme care to remove all traces of the previous solution, or better yet, use another tank. Silverplating is a two-step process; the work is first immersed in a "strike" solution that firmly bonds the silver to the copper, after which the plating is built up in a different solution. The strike solution consists of 8 oz. of sodium cyanide, ¾ oz. of silver cyanide, and 4 oz. of sodium carbonate, plus water to make 1 gal. *(Remember that the cyanides are extremely poisonous, and must be handled with great care!)* For anodes during striking, use strips of bright steel having a surface area equal to that of the work. The time of immersion of the work should be no longer than 1 min. at 6 volts. No agitation is needed. The work should now appear a dirty grey lightly tinged with brown.

For the silverplating itself, use a solution made up of 5 oz. of sodium cyanide, 3.2 oz. of silver cyanide, and 6 oz. of sodium carbonate, plus water to make 1 gal. Anodes should be of pure silver, again with surface area equal to that of the work. It's important to keep the voltage down to from .5 to 1 volt. Inspect the work periodically; it should be white with only a slight tinge of grey. If the color is darker, the voltage is too high and the plate may not adhere. If small nodules of silver form on the work, the voltage is too high or the anodes too close. Agitation with air is not essential but helps greatly in securing an even plate. END

Simple Setup Copperplates Baby's Shoes



A dry-cell current supply with a lamp to limit current are all that's needed for this rig.

COPPERPLATING a pair of baby shoes will not only please a mother for whom they have sentimental value, but will also afford an easy introduction to electroplating.

Mix plaster of Paris and water to a thick paste and fill the shoe to about ½" from the top. When it has set, apply two coats of waterproof varnish and allow to dry. Obtain a supply of powdered graphite of the sort used to lubricate locks and rub it thoroughly into the leather until the entire shoe is covered with a shiny coat of graphite.

In a fish bowl or other wide-mouth container dissolve 27 oz. of copper sulphate in 1 gal. of water, and then carefully add 6½ oz. of sulphuric acid. Connect three dry cells in series and run one lead through a 200-watt incandescent lamp to limit current flow. Connect the negative wire to some inconspicuous spot on the shoe and the positive lead to a fair-sized sheet of clean copper. During plating turn the shoe frequently, or else suspend it in the center of the jar surrounded by several copper anodes. Wash off the electrolyte, polish the shoe, and coat with clear lacquer.—H. L. KEYTON.

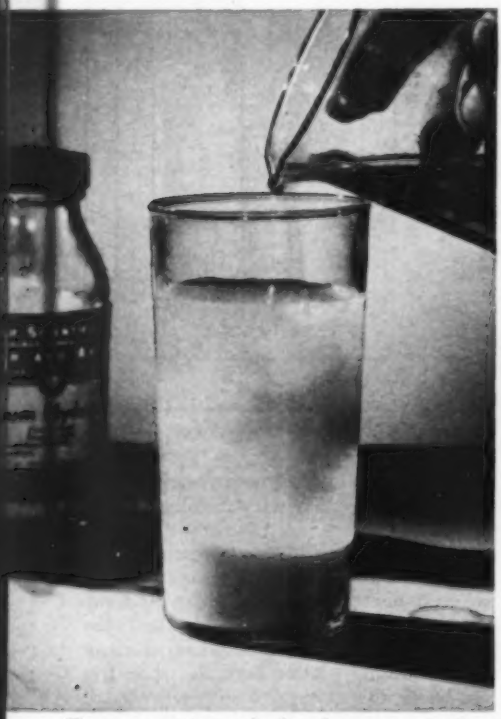
Chemistry Spins a Yarn

By Kenneth M. Swezey

TRANSFORMATION of tree fibers or cotton linters into rayon fabrics is one of the greatest achievements of modern industrial chemistry. Chemically, rayon is almost pure cellulose, the same as cotton and linen. But instead of using cellulose as found in nature, the rayon chemist starts with cheap and plentiful spruce and hemlock trees, or the fuzz that clings to cotton seed after it has been ginned. He chops these up, dissolves them, and then causes the cellulose to reappear in silky filaments that may be spun, twisted, knit, or woven into forms that compete successfully with cotton, silk, linen, or wool.

Although the rayon industry is less than 60 years old, and modern rayons less than 15, the idea that man might imitate the silkworm dates back to the 17th Century. In 1664, Robert Hooks, an English scientist, wrote that natural silk is merely a "glutinous excrement" from the body of a worm, and he wondered why men couldn't do as well by squeezing a suitable gum through tiny holes.

Count Hilaire de Chardonnet was the first to accomplish this on a commercial basis. One day while he was coating some photographic plates with collodion, the bottle slipped and broke on the table. When he tried to clean up the mess some time later, the partly dried collodion stretched into long threads. With this as a beginning, Chardonnet worked 30 years to perfect a



How rayon is made by the cuprammonium process may be shown at home. Add a sodium hydroxide solution to one of copper sulphate.

Copper hydroxide precipitates as a pale blue compound. Wash and filter this. Then dissolve in just a little strong ammonium hydroxide.

synthetic yarn. His "Chardonnet silk" was the hit of the Paris Exposition in 1889.

Other methods of taking cellulose apart and putting it together again as textile fibers were soon perfected. Early types were called artificial silk. In 1924, the name "rayon" was adopted for all textiles made artificially from cellulose.

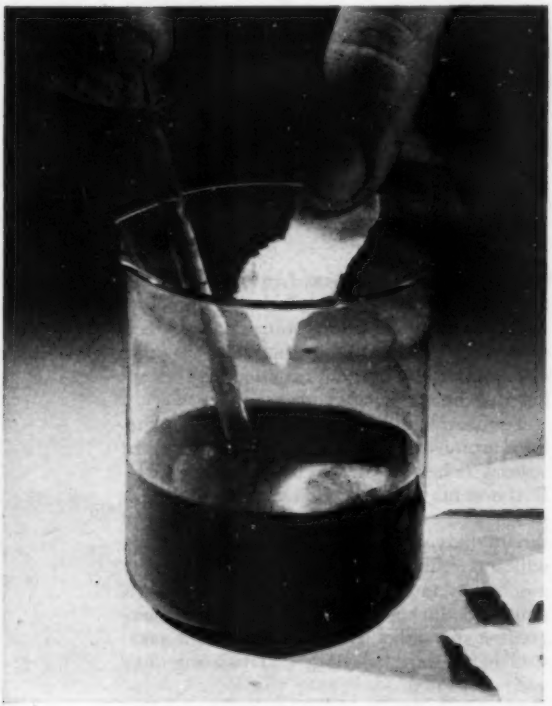
Most rayon is now made by the viscose process. Acetate rayon comes next, while cuprammonium, a superior rayon for certain special uses, is in third place. Although complex machinery and precise technical control are required to produce usable rayon yarn, you can readily demonstrate how cellulose in one form can be broken down and then "regenerated" in a form entirely different. The cuprammonium process has been chosen as the one most easily paralleled at home.

First, make some copper hydroxide by dissolving 5 grams of copper sulphate crystals in 100 ml. water and adding slowly a 10 percent solution of sodium hydroxide until the pale blue precipitate stops forming. Wash this precipitate by decantation—mixing with water in a tall glass, allowing to settle, pouring off the clear upper liquid, mixing with more water, and repeating the process five or six times.

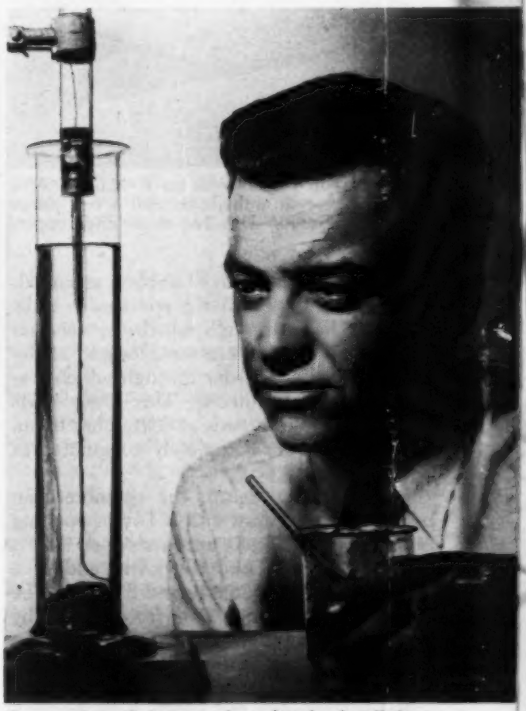
Filter the precipitate and dissolve the gelatinous solid in the smallest possible amount of 28 percent ammonium hydroxide. With the ammonium hydroxide, the copper hydroxide forms a complex deep-blue compound. The resulting solution (called Schweitzer's reagent from the German chemist who discovered it) dissolves paper, cotton, wood, and other forms of cellulose.

Commercially, cuprammonium rayon is made from cotton linters. If you wish, you may use absorbent cotton, but filter paper —a pure form of cellulose—will dissolve much faster. Tear up a 15 cm. sheet and put it into the blue solution. Stir occasionally until it has completely dissolved. This may take several hours.

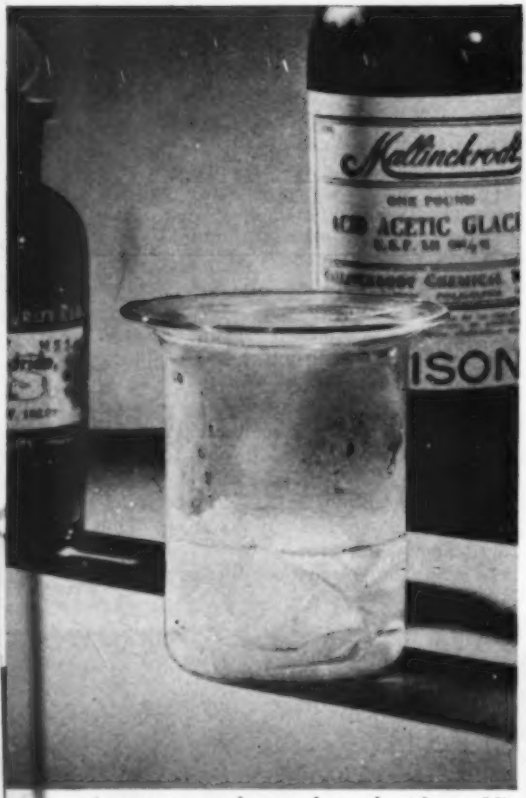
In commercial practice, the solution is



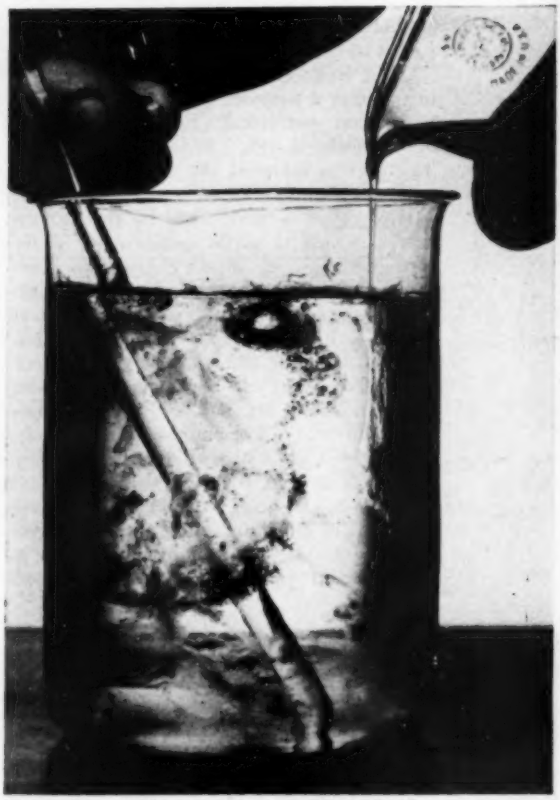
Called Schweitzer's reagent, this deep-blue solution dissolves cellulose. Dissolve enough filter paper to produce a syrupy solution.



Rayon thread forms when dissolved cellulose flows down through a small opening from the upper tank into a dilute sulphuric acid bath.



Acetate rayon also may be made at home. Mix acetic acid, acetic anhydride, and a few drops of sulphuric acid. Dissolve some filter paper.



Pour the solution slowly into a large beaker of water. This will precipitate the cellulose acetate. Remove from the water by filtering.

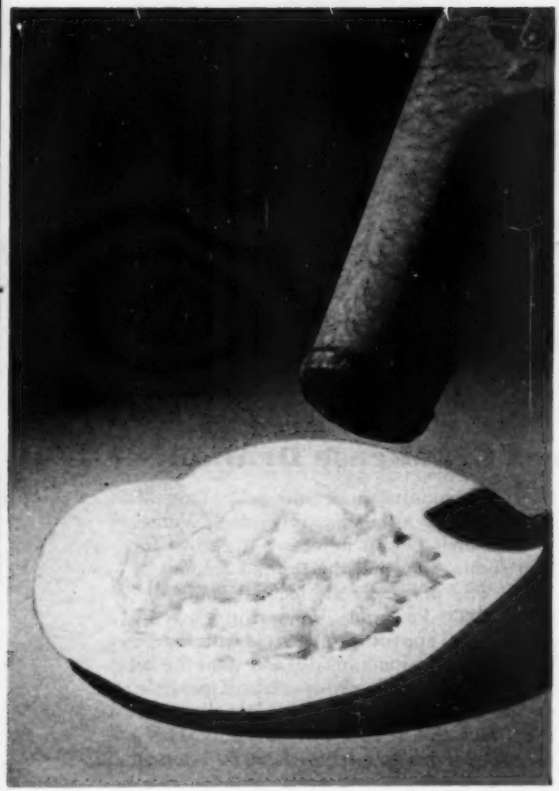
now filtered and air bubbles removed. Then it is pumped to the spinnerets—disks with tiny holes through which the solution is forced. The spinnerets are located at the upper end of a cylinder through which water is flowing downward. This water starts to coagulate the threads and stretches them. The filaments are completely coagulated in dilute sulphuric acid.

In your home setup, the spinneret can be a glass tube drawn to a 1-mm. opening at one end and fitted into a stopper that is inserted, in turn, into the lower end of a tube about 1″ in diameter and 6″ long. The large tube serves as a tank from which the solution can be gravity-fed to the coagulating bath, a 5 percent solution of sulphuric acid in a large cylinder.

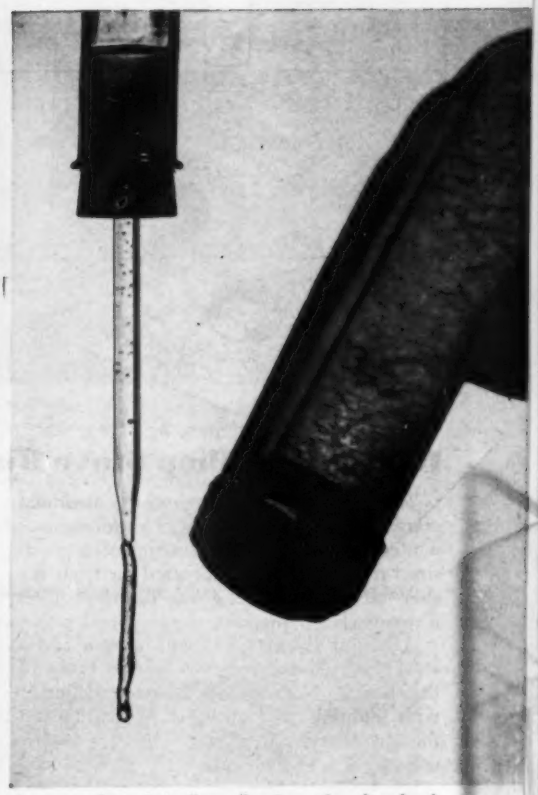
Before lowering the outlet tube beneath the surface of the coagulating bath, half fill the tank with the cellulose solution. Be sure the solution is free from undissolved cellulose as this would clog the opening. As a further precaution, run a fine copper wire down through the opening. By manipulating the wire, you can clear the opening if it becomes clogged.

To complete the experiment, lower the filled spinneret until the delivery tube is several inches below the surface of the bath. If the solution doesn't flow, give it a few prods with the wire. At first, the issuing thread may tend to rise, but gradually it will sink. Commercial cuprammonium filaments are much finer, of course, and are stretched during the spinning to give them greater strength. The final treatment consists of washing, drying, and twisting into yarn or thread.

Viscose rayon usually is made from cellulose derived from wood pulp. After being steeped in sodium hydroxide solution, this



Dry the compound thoroughly by blowing warm air over it. Then dissolve the dry compound in the smallest possible volume of acetone.



Acetate thread is "spun" when the dissolved cellulose acetate oozes from the tank at the top. Warm air quickly evaporates the solvent.

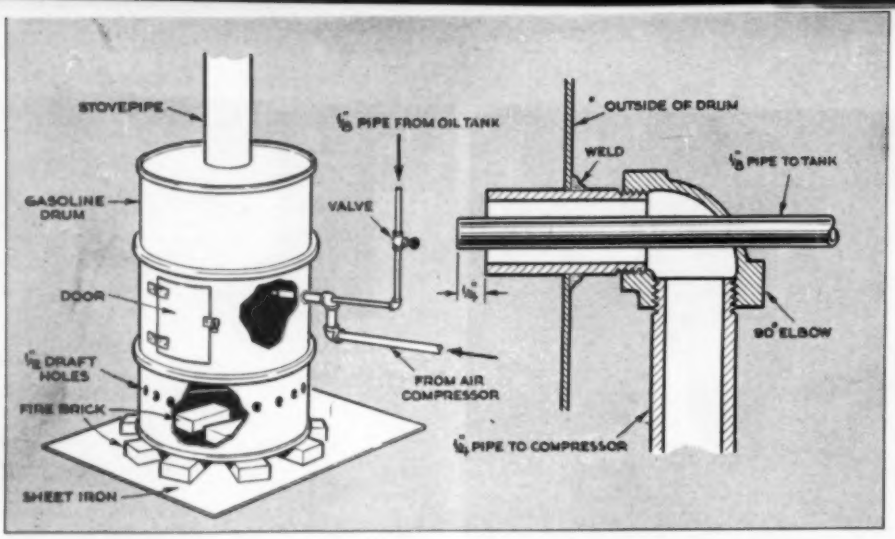
pulp is squeezed almost dry and allowed to age for several days. Treated with carbon disulphide, the alkali cellulose changes to cellulose xanthate. Dissolved in sodium hydroxide solution, this forms a viscous amber-colored solution that is forced through spinnerets in much the same way as cuprammonium solution.

Unlike cuprammonium or viscose rayon, acetate rayon is not merely cellulose that has been taken apart and put together again. Instead, it is a real compound of cellulose—cellulose acetate, the material of which most photographic film is made. All you must do to make filaments of this substance is to dissolve it in acetone, or other suitable solvent, squirt it through little holes, and finally pass it through warm air. The heated air rapidly evaporates the solvent, leaving a solid thread.

You can make cellulose acetate by dissolving 1 gram of filter paper in a mixture of 40 ml. of glacial acetic acid and 12 ml. of acetic anhydride, with 6 drops of concentrated sulphuric acid added as a catalyst. Complete solution will take at least eight hours. Stir it occasionally.

When the paper has been fully dissolved, you can recover the cellulose acetate by pouring the solution in a thin stream into a large volume of water, stirring constantly. Then separate the compound by filtering it, press out the excess water by squeezing the compound between filter papers, and dry—either in the open air or by directing upon it the warm blast from an electric drier.

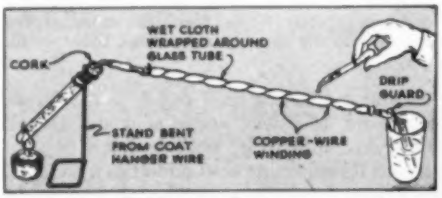
When dry, dissolve in the smallest possible amount of acetone. Place the resulting solution in the "tank" used in the previous experiment. This time the solution just flows into the air where heat from the drier solidifies it. END



Homemade Shop Stove Burns Crankcase Drainings

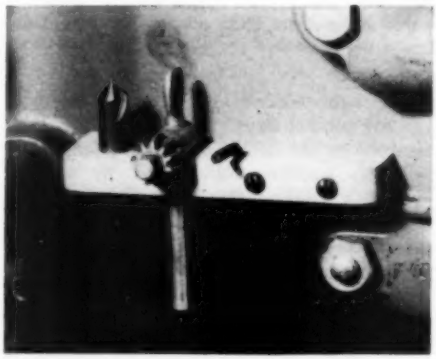
THIS efficient oil stove, which uses old crankcase drainings as fuel, has for several winters provided cheap heating of a good-sized repair shop. Compressed air from the shop air line "atomizes" the fuel and gives a steady, hot flame.

A 55-gal. drum, fitted with a door and a stovepipe chimney, serves as the body of the stove. The bottom is covered inside with firebrick, and a ring of bricks elevates the drum from the floor. The air nozzle consists of a short length of ¼" pipe welded to the drum. Inside it and protruding ¼" farther is the ⅛" fuel-supply pipe. Valves in both lines permit adjusting the stove for best combustion and the desired amount of heat. The oil reservoir, located some distance away for safety, feeds the stove by gravity. To start it, the stove is warmed by burning newspapers inside, and then the oil and air lines are slowly opened. If possible, use a long run of stovepipe to get the maximum radiation, fitting it if necessary with a device to check down drafts.—C. F. STRAHM.



Lab Still Uses Odds and Ends

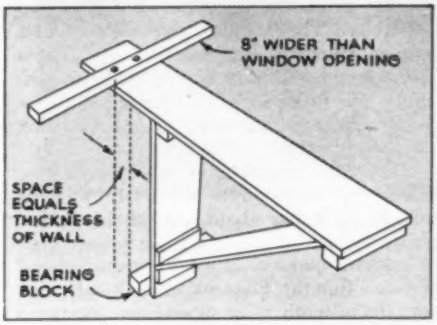
IN A few minutes you can put together the little distilling setup shown above, which is entirely satisfactory for many home-lab purposes. The wet cloth wrapped around the long tube will provide almost as much cooling as tap water circulating in a water jacket. Be sure to use a guard to keep the drip from the condensate. Don't apply heat too fast or unevaporated solution may bubble into the line. A few short pieces of glass tubing in the first test tube will keep big bubbles from forming. You'll find that an ordinary medicine dropper will provide a handy and controllable way of supplying water to the cloth.—JOHN L. STORY.

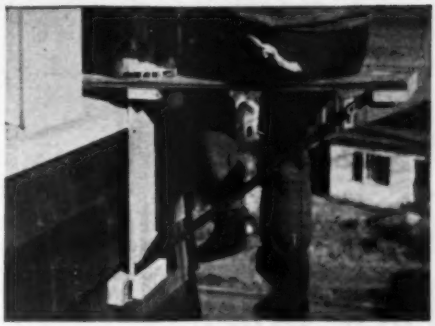


Drill-Press Rack Holds Tools

BOLTED to the drill-press head by two machine screws in tapped holes, this hardwood rack holds the chuck key, Allen wrench, and countersink where they can be easily found. A half-round groove is filed across the top of the rack over the chuck-key hole, into which the body of the key fits for orientation.—GLENN A. WAGNER.

Portable Platform Hooks On Window Casing



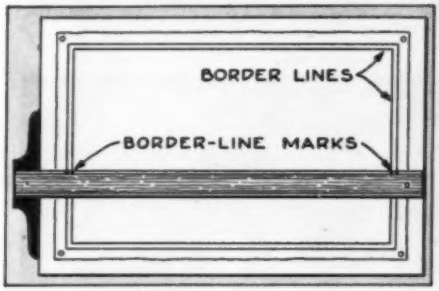


PAINTING upstairs windows usually involves manhandling an extension ladder into place and then teetering alongside the window during work. This homemade platform, set in place from inside the room, can be moved easily from window to window, and affords a steady and convenient working surface. Use sound hardwood for its construction, and pad the crosspiece to prevent marring the finish inside. Carriage-bolt assembly will allow compact storage when the unit is not in use.—J. RODGER DARLING.

Folded Paper Locates Centers

TO FIND the center of a piece of round stock, make a tracing of the work on thin paper. Holding the paper up to the light, fold it twice as shown. Then unfold the paper, place it carefully on the work, and prick-punch the intersection of the fold lines.

T-Square Marks Guide Borders



DESIGNERS and draftsmen frequently have occasion to lay out many drawings having the same border dimensions. To save time, scribe and ink in the width and height dimensions on the plastic edges of the T-square. Points are then made adjoining these marks at each edge of the drawing, and the T-square is inverted for use as a straightedge while the connecting lines are drawn.—JOHN G. KINGDON.

Baby Enjoys Carriage Window

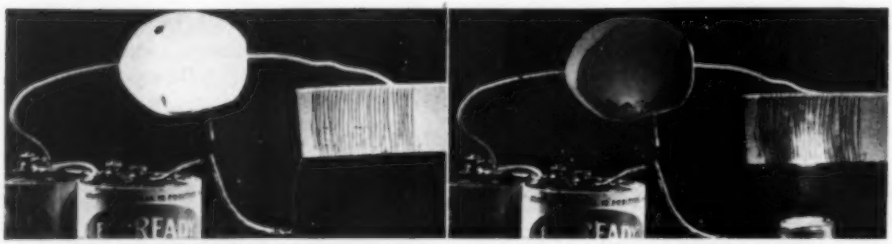
MOST very small fry like to lie on their stomachs, and in a carriage they also try to peer over the top. Often the result is that, on bumps, small heads are jounced against the carriage rim. I stitched a sheet of clear acetate in the front of the carriage, and now our youngster props himself solidly on his elbows and gazes out happily through his own private windshield while being rolled along.—LYELL D. HENRY, JR.

HOME EXPERIMENTS

How Heat and Electricity Affect Each Other

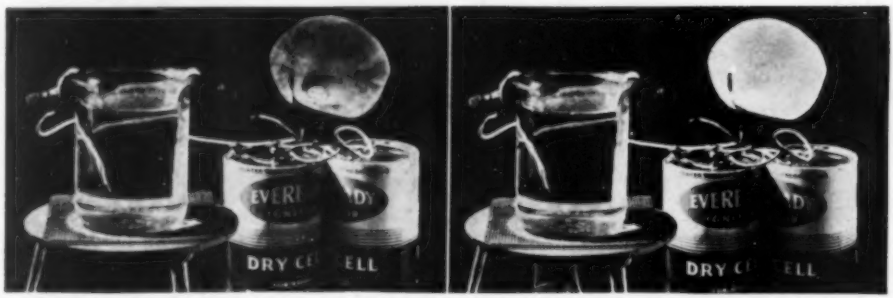
THAT all energy is somehow related is very evident in the behavior of heat and electricity. The toaster and electric iron convert kilowatts into useful heat. But a thermocouple—simply two pieces of dissimilar metals welded or soldered together—changes heat directly into electricity when one joint is put into a flame.

Heat affects electrical conductors too. When you turn on a 100-watt bulb, its cold filament has about a tenth of its hot resistance, and there is a tremendous surge of current—about 9 amp. for a millisecond or two. But the filament immediately gets hot. In a tenth of a second its resistance rises until it draws only its rated .8 amp.

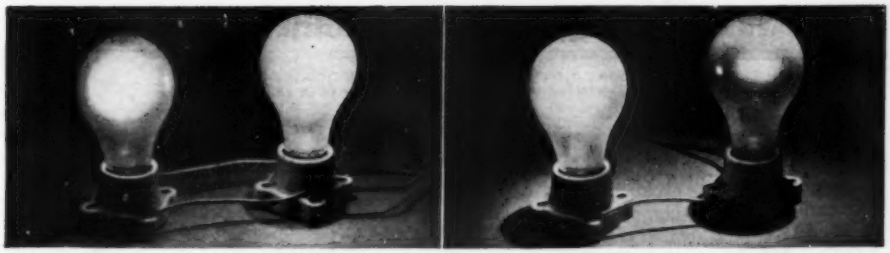


Heat Increases Resistance. You can safely use more lights on a single circuit without blowing a fuse if you turn them on one at a time. The reason? Almost all metals, including lamp filaments and heating elements, have greater resistance when they are hot than while cold. Hence, they pass less current after heating up.

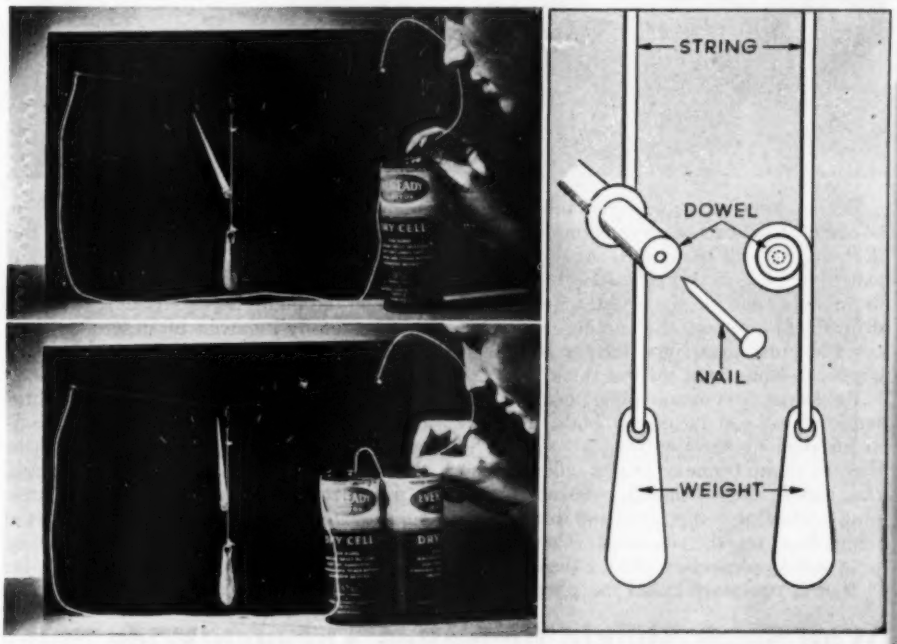
You can demonstrate this characteristic of metallic conductors by connecting a 3-volt flashlight bulb in series with two dry cells and about 10′ of thin iron wire wound around a strip of asbestos. While cold, the wire has a low resistance and enough current passes to cause the bulb to shine brightly. But put a flame under the wire, and the resistance becomes so great that the light will dim—and may go out.



Heat Decreases Resistance. In the case of conducting solutions, or electrolytes, the resistance decreases as they are heated—as you can demonstrate by another pair of tests. Connect your bulb and dry cells in series with two metal plates suspended in a water-filled beaker. Stir salt into the water until the bulb lights dimly. Now put a flame under the solution. As the solution becomes hotter, the light will grow brighter. Because of this lowering of resistance, electrolytic rheostats must be designed large enough to carry the current that is required without overheating.



Parallel Versus Series. Heat depends on the current and resistance in a circuit. Thus, if two or more appliances of similar type, such as light bulbs or heaters, are connected in parallel, the bulb or heater with the lowest resistance—which draws the greatest current—gives the most light or heat. As an illustration, the 60-watt bulb on the right in the left photo has less resistance and so gives more light than a companion 40-watt bulb. But connect the same two bulbs in series, as at the right, and the reverse holds true. The same amount of current now passes through both, but it creates more light and heat in the bulb where it overcomes the higher resistance.

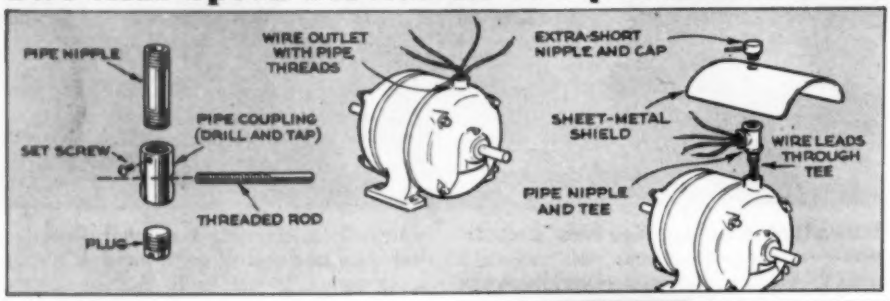


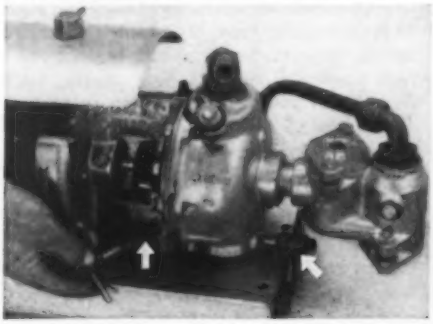
Heat Actuates Meters. Because the heat produced in a wire or circuit is proportional to the square of the current flowing through it, and because heated metals expand in a predictable way, the heating effect of electricity is used in one type of instrument to measure amperage or voltage.

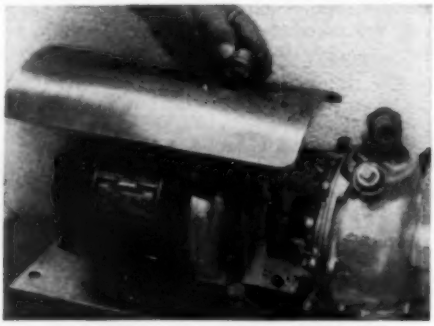
You can easily demonstrate the principle of a "hot-wire" meter. Stretch a strand of iron picture wire horizontally between two nails driven into a board. At the center, suspend a wire hook connected to a string held taut by a weight. Drill a hole through the center of a short dowel, cement a cardboard pointer to the dowel, and mount the dowel to turn freely. Loop the string once around the dowel so that the pointer moves to the right when the weight is pulled down.

Connect a single dry cell to the supporting nails, and the pointer will move slightly as the wire heats, expands, and sags. Connect two, and the movement will increase.

Two Aids Speed Service on Pump Located in Pit







PUMPS installed in pits and other hard-to-reach places can be serviced more readily if equipped with these aids. At the left, an extension plug makes it easier to open a drain hole, and at the right a removable drip shield protects the motor. To avoid corrosion, use brass pipe fittings and sheet copper or aluminum for the shield.

Replacing a common pipe plug, the extension plug can be conveniently removed or installed by hand without a wrench. So that the pump frame or fittings will not keep the handle from turning, assemble each plug with a pipe nipple of suitable length, depending on the location. Couple the plug and nipple as indicated in the drawing.

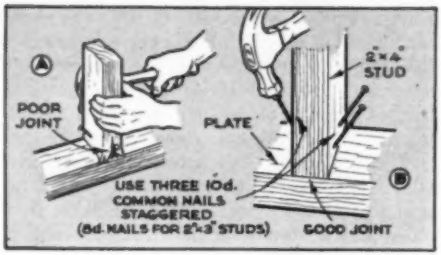
If it is necessary to fill the plug nipples to prevent leakage, use roofing cement or similar waterproof material for those on the discharge side. Fill those on the suction side with molten lead or other metal.

When the pump needs servicing, the drip shield is easily removed by unscrewing the short nipple and cap. A bracket made from a pipe nipple and tee is particularly suited to the type of motor shown, for the latter has a pipe-threaded wire outlet for convenience in mounting a pressure switch at this point if desired. Where this is the case, a pipe flange screwed on top of the pressure switch may be substituted for the bracket shown. A similar mount may be employed on motors having side outlets for the wire leads.—J. MODROCH.

Wall Studs Should Be Nailed Through Wide Sides

SOUND joints between wall studs and the plate are an essential framing requisite for either plaster or wallboard application, since weakness at this point leaves the surface without adequate support and is likely to result in cracks.

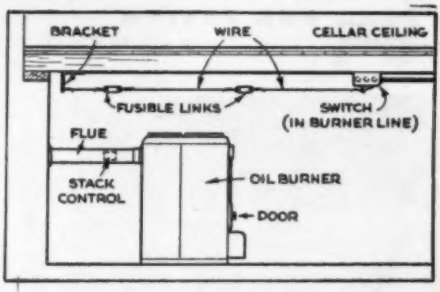
The joints will be weak if the nails are driven into the narrow face of the studs, as at A. Instead, nail only through the wide sides, as in B.



Fusible Links Shut Off Burner After Explosion

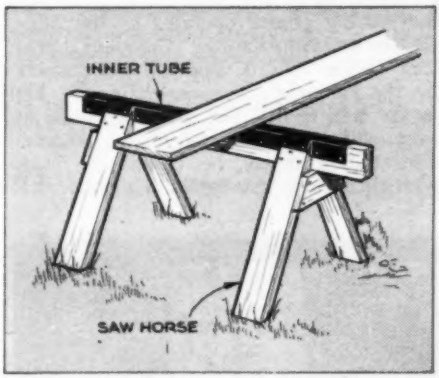
If your oil burner is not designed to shut down automatically in case of a "puff back" explosion, the illustrated setup will do the job—and prevent what might become a costly fire. Should the door be blown open or the flue wrecked by delayed ignition, the rising heat will melt a fusible link and allow the spring switch to open the burner circuit.

The switch should be a normally-open momentary-contact type. Connect the toggle arm to a wire that runs to the links, and tension the wire so that the switch is held closed, allowing the burner to operate. Install the switch in series with the hot side of the main line that runs to the burner.



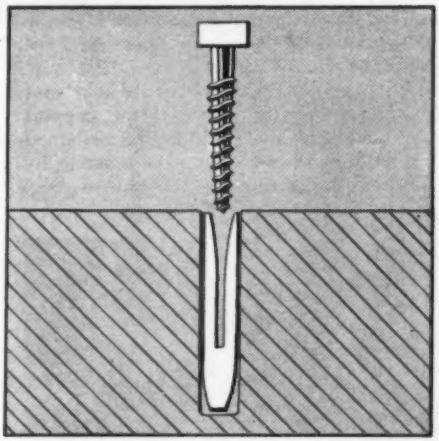
Use fuse links with a rated melting temperature of 160 deg., locating one directly over the furnace door and one or more over the flue pipe, depending on its length.

Tube Keeps Work on Sawhorse



Carpenters and others will find that boards do not have such a tendency to slide and slip while they are being cut on sawhorses, if a length of inner tube is wrapped over the ridge of each horse and tacked to the sides with roofing nails. Rubber on the horse supporting the free end of the work is especially helpful.—W. B. Eagan.

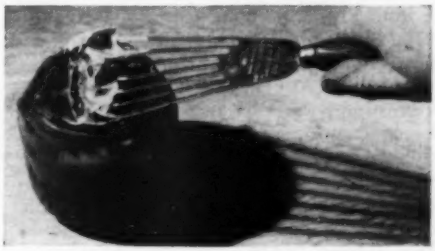
Clothespin Holds Lag Screw



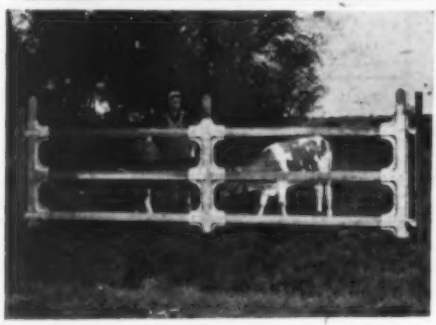
A clothespin inserted in a hole as above makes it possible to anchor a lag screw firmly in cement. The head of the clothespin may be cut off to save the work of drilling a deeper hole.—Richard Salzer.

Batter Beater Cuts and Lifts "Skin" from Paint

Usually available in a dime store, a batter beater will often be found a handy tool in the home paint shop. It will quickly cut and lift the "skin" that forms on the surface of paint left standing in cans for some time. Excess paint drains through the tines, and the skin does not slide off as it will from a knife. If the beater is too wide to fit small cans, one or more tines can be cut from each side.—Will Thomas.

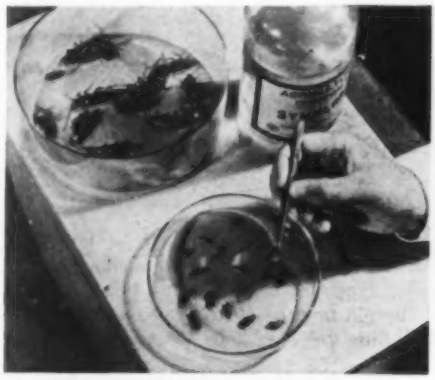


FOR EASIER FARMING

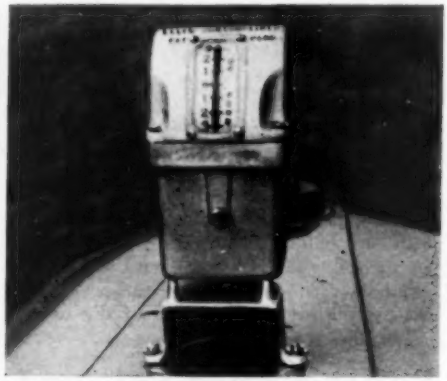


Gate Fits Any Opening. Steel members at the ends and center of this gate encase two-by-fours that may be cut so the length of the gate suits the opening. Supported by double hasp hinges, the gate swings in either direction and is held shut by a lever-operated latch. If the support post should sag, the gate may be realigned by a built-in leveler. The gate is made by Doughboy Industries, New Richmond, Wis.

Motorcycle Makes Hay. A motorcycle has been found useful in a hayfield at the proving ground operated by the Allis-Chalmers Manufacturing Company, near Elm Grove, Wis. Cylindrical bales made by the company's one-man baler are left in the field to dry, but must be turned at least once. This is the job of the motorcyclist. Riding slowly, he bumps the bales with the guard, turning them rapidly.



New Poison Kills Pests. Said to be four times as potent as DDT against certain insects, a new poison announced by the United States Rubber Company has been found especially useful against hordes of grasshoppers on western farm lands. Both a contact and stomach poison, it is called "Synklor" and has chlordane as the active chemical. Reported to be no more toxic to humans than DDT, the poison is available either as a liquid or a dust. A liquid form (above) quickly knocks out roaches.



Aids Contour Plowing. An instrument marketed by the Ellis Sales Company, of Fairfield, Iowa, makes it unnecessary for a farmer to survey a field and put out stakes to guide his tractor along a contour line. Mounted on the tractor facing the driver, the instrument has a dial calibrated in percent of slope above and below the level, or contour, line. Thus, after locating his key contours, the farmer can just start plowing, correcting his wheels whenever the indicator hand moves off zero.

Alice Faye and Phil Harris, stars of NBC's Sunday night Fitch Bandwagon, (7:30 P. M., E. S. T.) and daughter Phyllis are photographed by "Baby Alice" with a Whittaker Micro 16

Christmas Shopping made simple

by Alice Faye

Every woman with children knows what a chore Christmas shopping is. The children and family come first, which leaves little time to think, let alone shop, for friends and relatives.

The other day when we were posing this picture for our family Christmas card, I got an inspiration which I'm passing along to you.

Baby Alice was so amused by Phil's Santa Claus outfit that she wanted to make a snapshot of her Santa Claus Daddy with our Micro 16. Then it came to me how simple and gracious it would be to give a number of our closest friends one of these amazing little cameras for Christmas.

I pass this shopping tip to you with the thought it may help solve your Christmas gift problems too.

YOU TOO can *have* and *give*...

a Merry Christmas and Many Happy Pictures

WITH THIS NEW, TINY PRECISION-BUILT CAMERA

IT'S THE PRESENT OF 1947! The Whittaker Micro 16 is *Everybody's Camera*. Even if you have *never* taken a picture in your life, you can get big camera results with this tiny precision-built camera. It's so easy to use even a 5 year old child like "Baby" Alice Harris can operate it.

YOU SEE YOUR PICTURE as it actually is in the "true-view" finder. Simply press the "sure shot" button and the tiny "eagle-eye" lens does the rest. No focusing or fussing. Fixed focus eliminates measuring distances.

MAKE NATURAL COLOR SNAPSHOTS having the same fidelity as black and white with the Whittaker Micro 16. It's precision-built for perfect picture taking.

SEE IT AT YOUR DEALER'S NOW, or mail the coupon for *free* descriptive folder and an actual Micro 16 black and white print (size 2½"x3¼"), the same you take with this camera.

This Picture of Phil, Alice and Phyllis is actual size of the Whittaker Micro 16 color prints, only 40c each, 3 for $1.00

FAIR TRADED AT $29.50
INCLUDES EXCISE TAX

- ROTARY SHUTTER
- 3-WAY APERTURE
- ACHROMATIC LENS
- TRUE-VIEW FINDER
- CHROME CASE

Whittaker
PRECISION BUILT Micro 16

MADE BY MAKERS OF PRECISION AIRPLANE VALVES AND CAMERAS

WRITE FOR FREE FOLDER AND ACTUAL MICRO 16 PRINT

The Wm. R. Whittaker Co., Ltd., Dept. PS-12, 915 N. Citrus Ave., Hollywood 38, Calif. Please send me name of dealer nearest me, and folder describing Whittaker Micro 16, and *free* black and white print taken with this revolutionary camera. My name and address are:

NAME_____

STREET_____

CITY_____ ZONE_____ STATE_____

BE SAFE!

WHEN YOU BUY AN OIL FILTER ELEMENT

NOW AVAILABLE AT YOUR AC SERVICE STATION

Only the new "5-Star Quality" AC Oil Filter and Element has an acidproof glass cloth collector tube trap which prevents pollution of the oil stream and assures a free flow of clean engine oil.

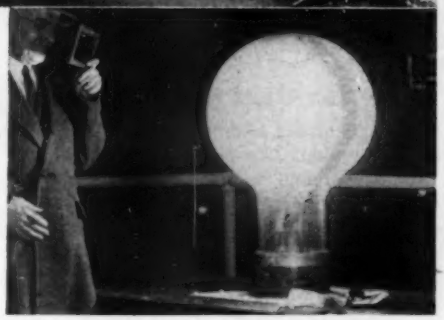
You can't afford to take a chance. This glass cloth trap actually means that your oil is filtered *twice*—for your protection.

AC SPARK PLUG DIVISION • GENERAL MOTORS CORPORATION

WHEN YOU WANT A NEW OIL FILTER, GET A NEW AC "5-STAR QUALITY" OIL FILTER . . .
and get these additional advantages

- POSITIVE END SEALS
- EXTRA STURDY BAIL
- MACHINED GASKET SEAT
- HIGH OUTLET RESTRICTOR POSITION
- EVEN DISTRIBUTION OF FLOW
- OUTSIDE-IN FLOW
- LONG FIBRE VIRGIN COTTON, RAM-PACKED
- EXTRA HEAVY METAL CASE
- EXTRA LARGE HEX HEAD DRAIN PLUG

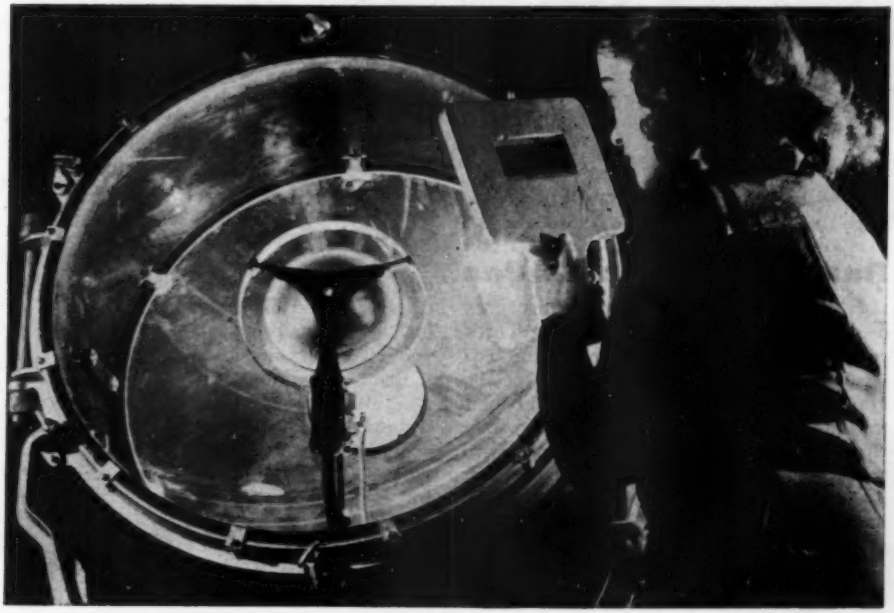
On the Brighter Side . . .



BASKING in the brilliance of 82 new-type GE street lamps, Schenectady's Erie Boulevard, shown above, becomes the eighth brightest lighted street in America. One of three recent contributions to better lighting, the new system averages more than two foot-candles of light over the street.

The big bulb at right is also a GE development. Its 50,000 watts make it the world's largest incandescent lamp. Although used at present only for demonstration, it paves the way to bigger and better lights.

Largest and most powerful incandescent searchlight for sea duty is the 24-inch, 1,500-watt Westinghouse giant shown below. It would take some 90,000 household bulbs of 60 watts to equal the brilliance of its 5,850,000-candlepower beam. Designed to go atop the pilothouse of a new ocean liner, the aluminum-and-bronze light can be operated by a single remote-control lever.



New Design Saves Space

THIS compact cleansing-tissue dispenser occupies about one-half the space required by conventional holders of the same capacity. Designed either for table use or for easy installation on kitchen or bathroom wall, the holder is molded of polystyrene in ivory, coral, and blue. It is made by Columbus Plastic Products, of Columbus, Ohio.

Battery Kept Up To Par

IT'S your own fault if the battery goes dead in this new electric hand lamp. Three colored balls tell at a glance when the battery must be recharged. Indicating specific gravity, all three appear level behind their transparent window when battery is fully charged. Drop of green ball means five percent discharge; white, 50 percent; red, 95 percent. For recharging, battery need not be removed, as charger can be plugged in. Made by U-C Lite, of Chicago, the lamp throws a 2,500-ft. beam.

Easier Color Printing

EKTACOLOR, a new negative color film developed by Eastman Kodak, is going to take a couple of the headaches out of making color prints. It eliminates the need for masking and for separation negatives.

The Ektacolor process is able to do this by using color couplers. These provide color correction as the film is developed, producing a negative image combined with positive color "masks."

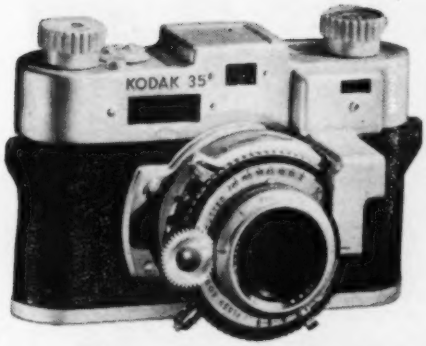
With most previous color films you must work from a positive transparency, and color correction is achieved by making one or more low-density, negative images as masks that then are bound in register to the transparency. Ektacolor completely eliminates this step.

The making of separation negatives is another tedious step in producing color prints from positive transparencies by the dye transfer method, since such negatives are needed to produce printing matrices. This process is also eliminated by the new negative color film, providing a second major saving of time and materials.

Working from the Ektacolor negative with color filters, positive printing matrices may be made directly on another new Kodak product—Pan Matrix film. Thus, in effect, Ektacolor provides in one film a set of corrected color negatives.

Black-and-white prints for use as proofs may also be made directly from Ektacolor negatives on special paper.

Intended primarily for professional use with artificial light, Ektacolor is designed for processing in a photographer's own studio. It will be supplied in standard film sizes for use in conventional cameras, and is expected to be available early in 1948.



For the miniature fan...

A KODAK 35 CAMERA WITH RANGE FINDER. Brilliant 4-element *f*/3.5 lens, *Lumenized* to block ghost images; 1/200-second Kodamatic Shutter; built-in flash synchronization. Modern refinements include double-exposure prevention, automatic film stop and shutter-setting. Moderately priced.

One of them is just right for YOU

For the artist-photographer...

THE KODAK REFLEX CAMERA. Twin taking and viewing lenses are *f*/3.5's, *Lumenized* to cut flare. Big, brilliant image makes it easy to study composition; tells you when focus is razor-sharp. 1/200-second Kodamatic Shutter; built-in flash synchronization. Sturdy cast-aluminum body. The most for your money in the fine-reflex field.

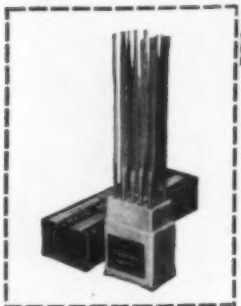
For the critical worker...

KODAK MEDALIST II CAMERA. Kodak Ektar 100mm. *f*/3.5 Lens—*Lumenized*—unsurpassed in correction for definition and color. Supermatic (1/400) Shutter synchronized for flash. Instant focus with coupled split-field range finder. Uses rolls, adapts to packs, sheets, or plates; pictures, 2¼ x 3¼. See your Kodak dealer.
EASTMAN KODAK CO.,
ROCHESTER 4, N. Y.

Kodak

"I know what I want

—even if I have to buy it myself"



NEXT to the products of his own handicraft, fine tools are the average "basement hobbyist's" greatest source of pride. Any one of these outstanding high-quality kits of Nicholson craftsmen's files will fascinate him.

•

Nicholson X. F. Swiss Pattern Files in handsome orange-and-blue plastic case . . . 12 assorted Round Handle Needle Files; lengths 4", 5½" and 6¼", according to cuts 0, 2, 4 and 6.

•

Nicholson Rotakit containing ten assorted Nicholson Hand Cut Rotary Files and Ground Burs with standard ¼" shank for use in regular electric power tool, flexible shaft or drill press.

•

Nicholson Rotaset containing 18 assorted Nicholson Hand Cut Rotary Files and Ground Burs with ⅛" shank for use in small-size electric power tool or flexible shaft.

OBTAINABLE THROUGH GOOD HARDWARE STORES AND INDUSTRIAL SUPPLY HOUSES

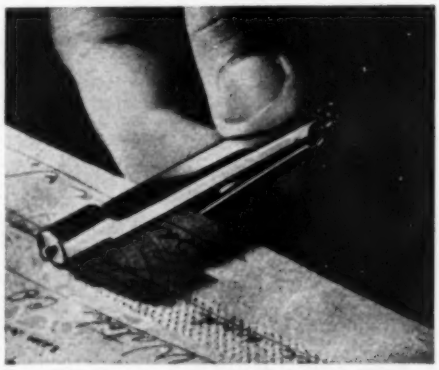
NICHOLSON U.S.A.

NICHOLSON FILE CO.
19 Acorn St., Providence 1, R. I.
(In Canada, Port Hope, Ont.)

NICHOLSON FILES FOR EVERY PURPOSE

Power Sharpens Pencils

IT DOESN'T take long to put a point on a pencil with this electric sharpener. Made by the Bert M. Morris Co., of Los Angeles, it points graphite or colored pencils to any of three grades of sharpness, operates on either AC or DC, and has a Tenite exterior of modern design. A draftsman's model is also made that sharpens only the pencil's wood.



Punch Protects Checks

A POCKET-SIZED check perforator not much larger than a small pair of tweezers is made by the Kaw Mfg. Co., of Long Beach, Calif. Tiny spiked rollers on the ends of the arms puncture the paper from both sides when rolled along a check.

THAT CUSHIONY FEELING LASTS LONGER WITH **MARFAK!**

It's a grand feeling to watch those artistic plastic designs take form. It's the same feeling of satisfaction you get when you drive your smooth-riding *Marfak* lubricated car.

• Cushiony driving and handling ease is a sure sign that *Marfak* sticks to its work, with bearing surfaces scientifically protected against wear . . . for a thousand miles and more. *Marfak* is designed to resist wash-out, jar-out and squeeze-out. Applied by chart, never by chance. Ask your Texaco Man to give your car that "*Marfak* feeling" today.

TEXACO

THE TEXAS COMPANY

TEXACO DEALERS IN ALL 48 STATES

TUNE IN: TEXACO STAR THEATER presents the TONY MARTIN show every Sunday night. METROPOLITAN OPERA broadcasts every Saturday afternoon. See newspaper for time and station.

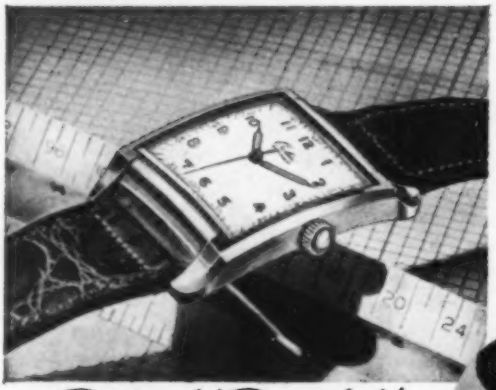
Portable Gas Generator

A PORTABLE acetylene-gas generator of new design, the Port-A-Matic, supplies fuel for an oxyacetylene welding torch safely, inexpensively, and just where it's needed. Easy to carry or lift to a bench, the model shown weighs only 25 pounds. While in use it can be knocked over or even turned upside down without fear of explosion, the maker says, since baffles keep water from reaching the carbide hopper.

13.5% more accuracy without winding

that's what you get with the

CROTON AQUAMATIC



You'll thrill to it! Your astonishing Croton Aquamatic tells true time *because you never wind it!* It's actually more accurate — *13.5% more accurate** — than watches wound by hand. Here's why. The scientific self-winding mechanism is wholly automatic — winds your watch as you move your wrist. So the danger of over-winding or running down is out! And it's got that "massive" look every man wants, to look well-dressed from dawn through dark. Made only by Croton — famous since 1878.

Douse it! Drench it!

You never have to remove your 17-jewel Croton Aquamatic when you swim or bathe. Before it goes to your jeweler, every watch is *certified waterproof* by the United States Testing Co., Inc. All you need do is make sure only your Croton jeweler opens, closes, and services your watch. Also: Dustproof, shock-resistant, radium dial easily read in the dark, the glass crystal can't shatter!

Smart square case of stainless steel, curved to your wrist. Model D Sweep Second..$39.50 Federal Tax Included

Croton

AQUAMATIC

*3 Aquamatics were tested against the average of 9 famous watches wound by hand, in a 30-day wearing test by a leading laboratory **Aquamatic proved 13.5% more accurate!** Write for free booklet. Croton Watch Co., Inc., 48 West 48th Street, New York 19.

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HASTINGS MICHIGAN

Dear Joe:

You'Re right, oil-pumping is the first sign of worn-out piston rings. And the only sensible thing to do Is hurry to a good mechanic and get them replaced.

Naterally I'd recommend Hastings rings. Cause I KNOW from experience they DO stop oil-pumping, restore engine performance and check cylinder wear.

Tough Guy

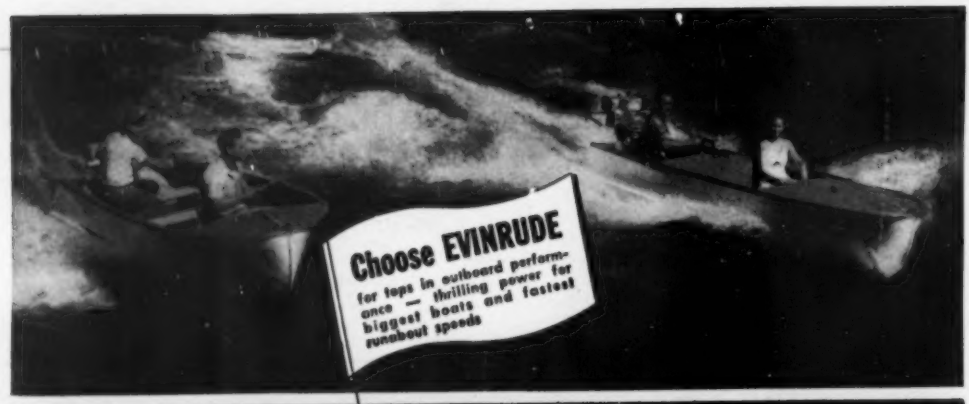
p.s. My boss says, "They'RE the best money you can spend on your car."

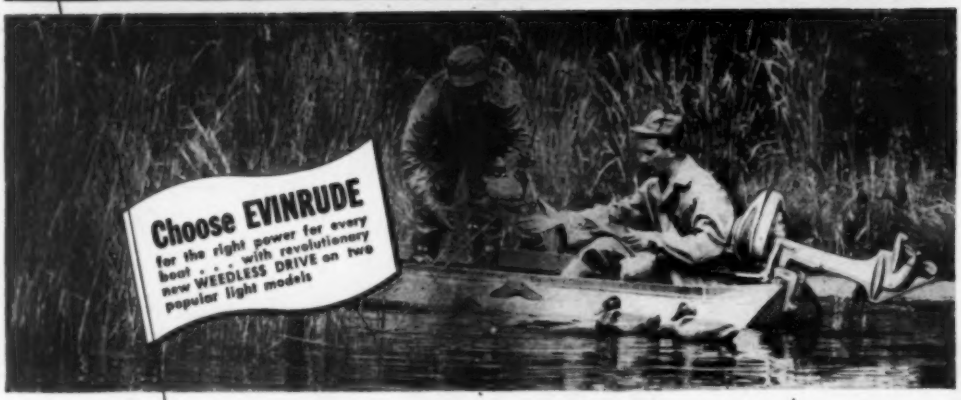
HASTINGS

STEEL-VENT PISTON RINGS

TOUGH *on Oil-pumping*
GENTLE *on Cylinder Walls*

HASTINGS MANUFACTURING CO.
HASTINGS, MICHIGAN
Hastings Ltd., Toronto





Choose Evinrude . . . for the certainty of fine performance that means utmost satisfaction and enjoyment for years and years ahead.

See your Evinrude dealer—look for his name in your classified phone directory under "Outboard Motors". For free catalog of the complete Evinrude line write, EVINRUDE MOTORS, 5657 North 27th Street, Milwaukee 9, Wis.

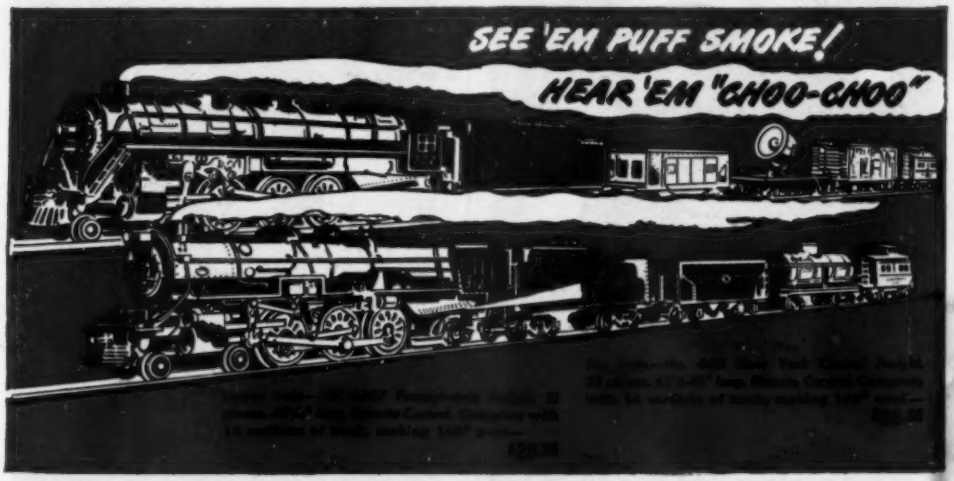
EVINRUDE

FIRST IN OUTBOARDS **38th YEAR**

In Canada: Evinrude Motors, Peterboro, Ontario

AMERICAN FLYER

Developed at the GILBERT HALL OF SCIENCE



THE ONLY SCALE MODEL TRAINS WITH ALL THESE THRILLING FEATURES

- ★ **Real smoke synchronized with train speed**
- ★ **"Choo-choo" sound effects synchronized with train speed**
- ★ **Realistic 2-rail track—no old-fashioned third rail**
- ★ **Trains and track built to uniform 3-16" scale**
- ★ **Spectacular new Electronic Propulsion locomotives**
- ★ **Billboard whistle—works with any train system**

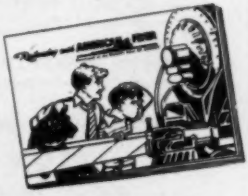
The new American Flyers bring you all the wonder and glory of railroading. They puff real smoke. The built-in "choo-choo" reproduces the choo-choo sounds of a real locomotive under full steam. Both smoke and "choo-choos" vary in intensity as you increase or decrease the speed of your train. Locomotives, tenders, cars and track are all built to uniform 3-16" scale, so that your train looks like real—hugs the track like real. Cars have automatic couplers that couple anywhere. Uncouple by remote control. Die-cast locomotives have superpower worm drive that assures smooth, steady pull at all speeds from a crawl to 120 scale miles per hour. See and hear the sensational American Flyers at your nearest department or toy store.

See . . . American Flyer's 2-rail track has no old-fashioned third rail in the middle. "T" design rail. Looks just like the track of a real steam railroad.

When in New York visit the famous Gilbert Hall of Science, Fifth Avenue at 25th Street. Admission free. The A. C. Gilbert Company, New Haven, Conn. Also makers of the famous Erector, Gilbert Chemistry Sets, Microscopes, Tool Chests and other Gilbert Scientific Toys.

HURRY! Send for this Colossal Illustrated Train Book

32 big pages with full color illustrations of all American Flyer trains and spectacular equipment. Advance news on sensational new Electronic Propulsion Locomotives, automatic coal loader, log loader, and other latest developments in scale model railroading. Mail coupon with 10¢.



Gilbert Hall of Science
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I enclose 10¢. Please rush colossal illustrated train book.

Name.....

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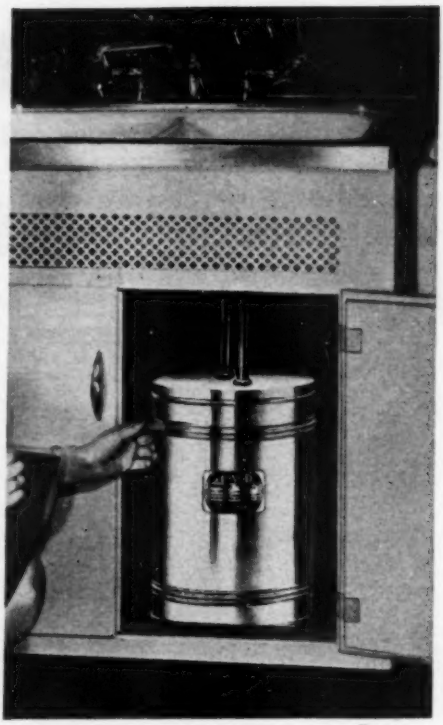
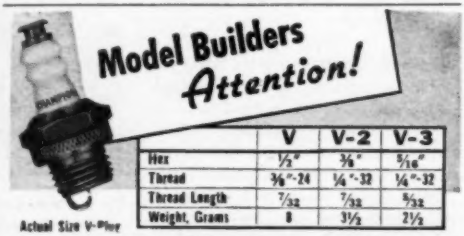
City.....State....

This offer good only in U.S.A.



Compact Water Heater

HOT water for a small home or business establishment is provided by the compact electric heater shown above. The thermostat is set at 180° F., and, as hot water is drawn off, a twin-band element insures fast reheating of the remaining liquid. Made by the Vacuum Can Co., of Chicago, the heater has an inner tank and outer shell of stainless steel. Insulation that will not deteriorate surrounds the inner tank.



	V	V-2	V-3
Hex	1/2"	3/8"	5/16"
Thread	3/8"-24	1/4"-32	1/4"-32
Thread Length	7/32	7/32	5/32
Weight, Grams	8	3½	2½

Champion Spark Plugs for model gas engines give the same dependable performance as regular Champions. Champion Ceramic insulation—Sillment sealed. Alloy needlepoint electrodes for easy starting. One piece construction.

CHAMPION

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Dependable

CHAMPION

AMERICA'S FAVORITE SPARK PLUG

A new set of dependable Champion Spark Plugs is just the thing to make your car start like the proverbial scared rabbit. Quick starts, faster warm-up, and all 'round better engine performance result in substantial gas savings. In addition, they'll reduce excessive drain on the battery, and minimize the danger of crankcase dilution. Now is the time to have your Champion dealer check your spark plugs. Be sure to get dependable Champions if you need new ones. Champion Spark Plug Company, Toledo 1, Ohio.

FOLLOW THE EXPERTS

DEMAND NEW DEPENDABLE CHAMPIONS FOR YOUR CAR

Listen to the CHAMPION ROLL CALL . . . Harry Wismer's fast sportscast every Friday night, over the ABC network

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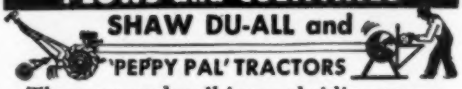
SHOVELS SNOW, SAWS WOOD
PLOWS and CULTIVATES



SHAW DU-ALL and 'PEPPY PAL' TRACTORS

These rugged walking and riding tractors pay their way the year 'round. Plows, discs, harrows, hauls, operates lawn mower, cutter bar, spray, bulldozes, plows snow, runs wood saw and other belt machinery.

Ideal for small farms, orchards, truck gardens, poultry farms, golf courses and estates.

Easy to change attachments with improved Jiffy Hitch. Patented tool control allows quick adjustment for wide hills or crooked rows. Sturdy, extra-strength construction means low upkeep cost. Operates for only a few cents an hour.

LOW FACTORY PRICES

Buy direct and save. Mass production holds prices down—quality up. Anyone who has a garden can afford a "Peppy Pal". Write for FREE folders and price list.

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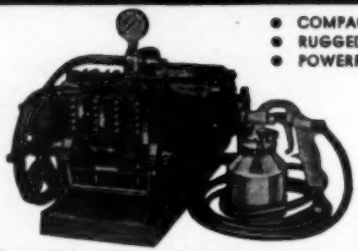
PRESSURE QUEEN

FOUR CYLINDER
PORTABLE AIR COMPRESSOR
SPRAY PAINTING OUTFIT

- COMPACT
- RUGGED
- POWERFUL



Immediate delivery on compressor with motor

AMAZINGLY LOW PRICED FOR THE ONLY FOUR CYLINDER UNIT ON THE MARKET

The ideal air supply for home and farm workshop, machine shop, garage and contracting painter; for product finishing, inflating tires, painting automobiles, trucks, machinery, etc.

This *4 cylinder compressor* has drop forged crankshaft, stainless steel, heat treated valves; bronze bearings and positive forced feed lubrication. Maximum pressure 50-60 lbs., free from pulsation. Standard equipment includes the compressor mounted on steel base with carrying handle, belt, compressor pulley, air chamber, air gauge, 15-ft. hose, spray gun; ½ or ⅓ h.p. motor or gas engine. Immediate delivery.

If your dealer does not sell Pressure Queen write direct

THE CAMPBELL-HAUSFELD CO.
151 RAILROAD AVE. HARRISON, OHIO

Christmas Suggestion . . .

for the man who owns, or plans to own a workshop, no gift could bring more pleasure.

Logan

A NAME TO REMEMBER WHEN YOU THINK OF BETTER LATHES AND SHAPERS

9-inch swing
18 inches between centers

A LATHE TO DEPEND ON

Logan Ruggedness and Lasting Accuracy . . . at $159.50

This compact Logan 9-inch Lathe handles manufacturing operations with the same speeds and precision that make the larger Logan Lathes outstanding in industry. For general machine shop and tool room work, farm equipment maintenance, and home workshop projects, it is equally effective. The ball bearing spindle mounting, the self-lubricating bronze bearings at other vital points, and the V and flat bed ways precision ground to within .0005" of parallelism are typical of Logan advanced design. Rugged, rigid construction makes it steady on heavy cuts. See this outstanding 9-inch lathe at your Logan Lathe dealer's or write for information.

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THE BRUSH WITH THE STEEL BACK

MD

Sweeps cleaner, faster— Out lasts ordinary brushes 3 to 1!

Mail Coupon Today

Milwaukee Dustless Brush Co.
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Please send me complete information about Speed Sweep brushes.

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Street Address _____

City, State _____

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BETTER PICTURES

THE FAMOUS

Exposure Meter

"the choice of experts"

Type DW-58 *Big Value* only $19.95* Federal tax included

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NEW Deluxe Type PR-1

Superb gift for expert or beginner. Vest-pocket size. Remembers the light it sees . . . pointer lock can't forget! Many other advantages. Ask your photo dealer. Or write for information. General Electric, Schenectady 5, N. Y.

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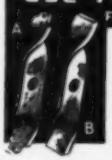
USE YOUR BENCH SAW

FOR JOINTING & CUTTING MOULDINGS



With our six inch tool steel cutters make mouldings, casings, drop-leaf tables, grooves beading and jointing. Moulding cutters, A 1 in. wide $1.50. 1½ in. $2.00. Jointing cutters, B 1 in. $1.50. 1½ in. $2.00. K 1 in. for drop-leaf tables. $1.50. E 1½ in. Makes ¾ in. cove & Quarter. $2.00. Postpaid. Guaranteed. State size hole. List & Folder free.

JOHN A. SANDSTROM
Rt. 1-P. Clearwater, Fla.

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save oil, save gas, restore original power

Send postal for free booklet on oil-saving.

SEALED POWER CORP., DEPT. H6, MUSKEGON, MICH.

L-M **CARBIDE SCRIBER**

NON-MAGNETIC

Tungsten Carbide — carefully ground on diamond laps, brazed into stainless steel 6" handle for marking steel and other metals — for etching, marking, cutting glass. In plastic case with pocket clip.

$2.00 PRICE POST PAID

PRICK PUNCH

Tungsten carbide tip, silver brazed into 3½" heat treated steel body.

with Carbide Tip.... $1.50

Price Post Paid

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5051 SOUTH LAKE DRIVE • CUDAHY, WISCONSIN

When you want to fix things fast . . . remember Weldwood Glue. It's quick to mix . . . easy to use . . . tremendously strong . . . stain-free . . . rot-proof . . . and permanent. At hardware stores, lumber yards, chain stores.

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PLASTIC RESIN
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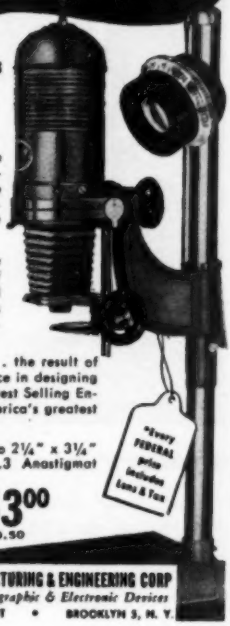
United States Plywood Corporation, New York 18, N. Y.

Completely New and COMPLETE

Federal's Low Price INCLUDES A Highly Corrected Enlarging Lens



When you examine the price tags of the new Federal Enlargers remember that the price on the tag is *for a complete enlarger . . . LENS AND TAX INCLUDED.*

For Federal's low prices are not arrived at by stripping off important enlarger parts and listing them as separate items in order to give the impression of low price.

Federal's prices are low! . . . the result of years of specialized experience in designing and building "America's Fastest Selling Enlargers" . . . undeniably America's greatest enlarger values.

MODEL 312. For miniature to 2¼" x 3¼" negatives. Fedar: 3½" F:6.3 Anastigmat with Iris Diaphragm.

Complete with lens Tax Included **$53.00**

Model 315 (as illustrated) $89.50

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FEDERAL MANUFACTURING & ENGINEERING CORP
Makers of Photographic & Electronic Devices
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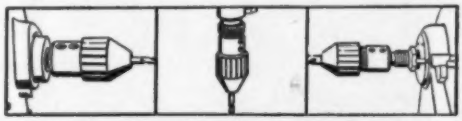
See These New JACOBS CHUCKS for the HOME SHOP

HEX-KEY Model
for drill presses, lathes and motor shafts

★ 4 models, capacities up to ½"
★ straight hole design to fit ½" or ⅝" shafts
★ fits plain end drill press spindles, motor shafts, and other powered shafts
★ special arbors for Morse Taper spindles



Easily fitted to the shaft, makes a motor into a power tool of many uses.

Holds drills, grinding wheels, sanding drums and other accessories.

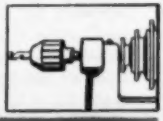
For chucking jobs on small work, chuck can be held in lathe spindles.

HAND-TITE Model
for hand drills, flexible shafts, polishing heads.

★ 3 sizes for tools with spindles up to ½" dia.
★ 2 diameters to fit ⅜" or ½" spindles.

Greater gripping power and dead-center accuracy for drills.

On a bench grinder, this chuck gives a horizontal drilling set-up.



RUBBER-FLEX Jaw Assembly

One-piece construction . . . hardened alloy steel jaws bonded together by oil-proof synthetic rubber . . . no loose jaws or springs. Tremendous gripping power. Accuracy not previously possible in popular priced chuck.

SEE *these 2 new Jacobs Chucks at your hardware dealers.*

THE JACOBS MANUFACTURING COMPANY, Hartford 2, Conn.

Please send your new illustrated folder on the Jacobs Rubber-Flex Hex-Key and Hand-Tite Chucks.

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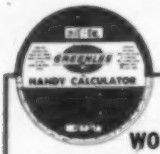
THE NAME FOR SOLID-CENTER AUGER BITS OF HIGHEST QUALITY

GREENLEE 22 is a name it will pay you well to remember whenever you buy Auger Bits. For it assures you sharp cutting edges, accurate sizing, bright, high finish, and that smooth, easy action so necessary in fine craftsmanship. You can be certain, too, that every GREENLEE 22 Solid-Center Auger Bit is "factory sharp" when it reaches you. For each is "Plastic-Sealed" with a special protective coating to keep it in perfect condition for the exacting work you will surely want to do with it. To buy top quality, buy GREENLEE.

TOOLS FOR CRAFTSMEN
GREENLEE



SPECIAL OFFER . . .
ONLY 10¢ FOR HANDY
WOODWORKING CALCULATOR

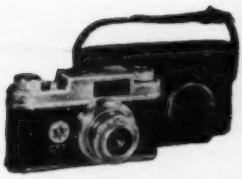
Quick solutions to countless woodworking problems. Converts linear to board feet, gives slope per foot, nail and bit sizes, etc. 6" diameter. Send coin to Greenlee Tool Co., 2132 Columbia Avenue, Rockford, Illinois.

Lights as It Oils

EVEN in the darkest crannies you can always see what you're oiling with this can. A flashlight is built into the top and focused toward the spout. The battery is set in the handle. Rogers Realty Co., of Oklahoma City, developer of the can, describes the one above as handmade; its appearance will be changed before it is marketed.

Fender Floats as Buoy

THIS boat fender doubles as a buoy. Molded of durable synthetic rubber, the Fender Float's five-pound internal air pressure makes it buoyant as well as a cushion between a boat and a wharf.



ARGUS MODEL 21

Only Argus 21 has "Markfinder" sight. Center cross-mark speeds aiming. Guideline border improves framing. F3.5 Anastigmat lens coated, color-corrected. Double-exposure guard. Synchronized flash. Speeds 1/10 to 1/200. Takes 35mm. film. Flash unit extra. $8.75

Price: $42.50
Fed. Excise Tax: 8.50
Carrying Case: 7.08
TOTAL: $58.08

ARGUS MINCA

F9.7 precision-ground double lens—the fastest lens of any camera in its class. Three easy-to-use settings for all outdoor pictures. Fast, accurate shutter: 1/80 of a second helps eliminate blurry pictures. Takes 828 film.

Price: $8.53
Fed. Excise Tax: 1.42
TOTAL: $9.95

TWIN-LENS ARGOFLEX*

Avoids tilting, cropping, prevents faulty focus. You see your picture before you take it. F4.5 Anastigmat, coated, color-corrected lens. Speeds, 1/10 to 1/200. 12 exposures (2¼ x 2¼) on 620 roll. Carrying case.

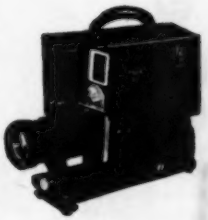
*REG. U.S. PAT. OFF.

Price: $52.40
Fed. Excise Tax: 8.50
Carrying Case: 8.73
TOTAL: $69.63

ARGUS PROJECTOR

Uniform illumination to edges. Designed to keep slides safe from heat. Takes slides right side up. Projects your favorite 35 mm or Bantam slides with unusual clarity. Film strip adapter available for showing unmounted 35 mm or Bantam film strips, $3.95 extra.

Price: $31.85
(Complete with carrying case)



This Christmas

GIVE AN ARGUS

...the kind of gift you'd like to get!

What is there about an Argus that makes it such a wanted gift? Simply this: Every Argus product is rigidly engineered to meet the exacting requirements of the critical camera fan. That's why, when you give an Argus, you know you give your best. So — see your Argus dealer today. He'll give you sound advice in helping you select the Argus gift you want.

ARGUS, INCORPORATED • ANN ARBOR, MICH.

argus

ARGUS MODEL A-2

F4.5 Anastigmat, coated, color-corrected lens. Automatic shutter with speeds from 1/25 to 1/150. Built-in extinction-type exposure meter. Optical viewfinder. Takes 35 mm film.

Price: $27.50
Fed. Excise Tax: 4.58
Carrying Case: 5.50
TOTAL: $37.58

ARGUS C-3

Coated, color-corrected F3.5 Anastigmat lens. Synchronized flash attachment. Accurate, lens-coupled, split-field range finder. Shutter speeds, 1/10 to 1/300. Takes all standard 35 mm film.

Price: $56.75
Fed. Excise Tax: 8.50
Carrying Case: 9.46
TOTAL: $74.71

FINE CAMERAS, PHOTOGRAPHIC PRODUCTS AND PRECISION OPTICAL INSTRUMENTS

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for 8 mm.–16 mm. sound-silent home projectors

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Picture pageant of life in lovely, languorous Bali—heavenly island you've dreamed about!

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What a crazy Christmas morn when pups get tangled in the presents. See them battle Tuffy—the terrific toy tank!

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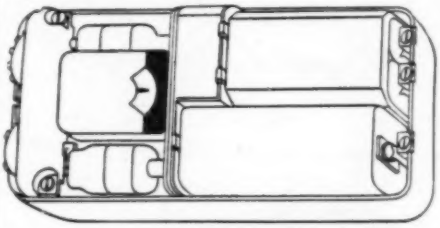
B-12

PICTORIAL FILMS, Inc.
625 MADISON AVE. NEW YORK 22, N. Y.

Oil Gauges Air Speed

CASTOR oil has added another to its many uses in this Westinghouse gauge to study air velocities in an electronic air cleaner. The center tube holds the castor oil, while the two bottles on either side contain salt water. Air entering the right-hand bottle forces a salt-water bubble up into the oil. By varying the pressure until the bubble lines up with a hairline marker on the magnifying scope, the velocity of the entering air can be accurately determined.

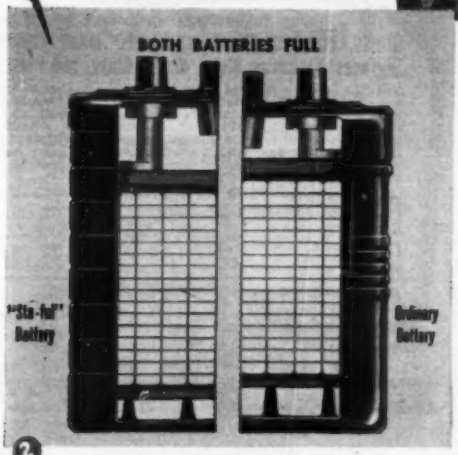


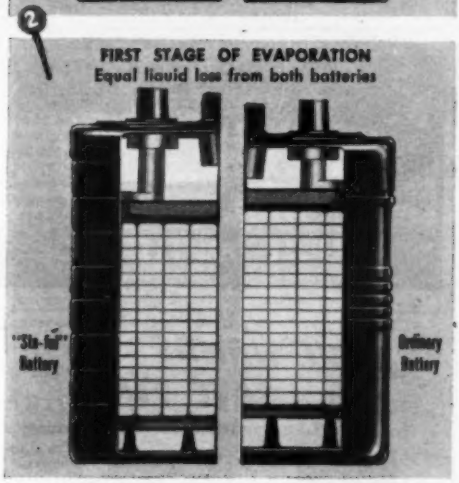
Ear Aid Tests Own Life

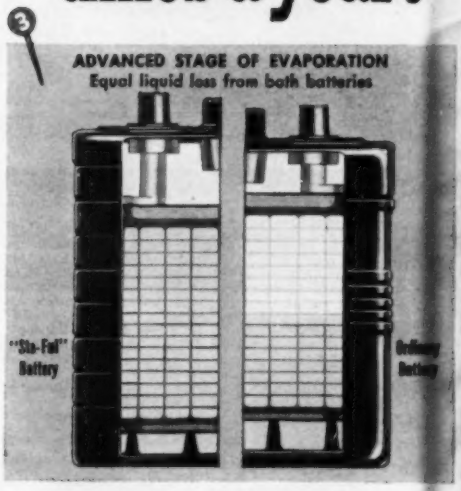
TO PREVENT battery failure, the latest Otarion hearing aid, diagramed above, boasts its own built-in battery tester. A Metrodyne voltmeter, it tests both A and B batteries and indicates their probable hours of service. It also helps localize operational troubles by eliminating the batteries as a possible cause. The entire instrument, including tester, weighs eight ounces.

HERE'S WHY NEW AUTO-LITE "Sta-ful" BATTERY...

needs water only 3 times a year!*







LASTS LONGER TOO! *In normal car use, because of "Sta-ful's" extra liquid reserve, plates are kept submerged to help deliver full life and power, when the same liquid loss leaves the plates in ordinary batteries exposed and inactive. This "Sta-ful" principle, oversize electrical capacity, plus Fibre-glass insulation, give longer life than batteries without Auto Lite "Sta-ful" features.

AUTO-LITE BATTERY CORPORATION
Toledo 1 Ohio

AUTO-LITE *Sta-ful* BATTERIES

NO OTHER TOOL LIKE IT

BURGESS vibro-tool

Trade Mark Reg. U. S. Pat. Off.

- WRITES ON STEEL
- DECORATES GLASS
- ENGRAVES JEWELRY
- CARVES WOOD
- TOOLS LEATHER
- CUTS CARDBOARD

Works by Vibration!

Whether you work with metal, wood, glass, plastics or leather, your shop is not complete without a Burgess Vibro-Tool. Totally unlike anything else on the market! Writes like a pencil on hardest steel! Engraves, carves, hammers and cuts. Only $7.50 at your dealer. If he cannot supply you, write to us and we will arrange for shipment.

BURGESS BATTERY COMPANY
Handicraft Division
Lake Zurich, Illinois

ORDER REPLACEMENT ACCESSORIES NOW!

V 5 Standard Needle..$0.15
V 3 Heavy Duty Needle.$2.00
V 80 Diamond Point Needle $5.95
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V 82-87 Leather Tools including punch, liner, deerfoot, spoon, double liner and cupper $1.50
V 23 Straight Edge Surgical Steel Knife.....3 for $0.50
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V 51-56 Assorted Carving Chisels..... ...6 for $1.50
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DE LUXE KIT *only* $16.50

Contains Vibro-Tool and 22 attachments, everything necessary for metal marking, jewelry engraving, leather tooling, wood or linoleum carving, pattern cutting, metal embossing, etc. Includes sharpening stone. Each unit individually packed in handsome, natural finish, wood storage chest. An ideal gift for any hobbyist.

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Please arrange for a Vibro-Tool dealer to ship the following:

☐ Vibro-Tool ☐ De Luxe Kit ☐ Accessories { Please list parts wanted by number
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NOW! For Only $5.95 You can have an Amazing New FLEXIBLE SHAFT TOOL

with PENCIL-SIZE HANDPIECE

Grinds, Polishes, Sharpens, Cleans, Mills, Carves, Engraves, Etches on Metal, Wood, Glass, and Plastic

Now you can turn your old motor, drill press, or electric drill into a Flexible Shaft Tool. Amazing new Presto-flex, latest addition to the Foredom flexible shaft family. Simply attach to your electric drill, drill press or motor. **Presto**—a flexible shaft machine! Off again in a jiffy! Pencil size handpiece gives you finger-tip control. Gets into tight places you can't reach with any other tool. Handy 35" overall length. And—only $5.95 complete! Order NOW.

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Just send your name and address. We will rush your **Presto-flex** COD. Pay postman $5.95 plus postage or send $5.95 now and WE pay postage. Money back if not **delighted!** If you order **Presto-flex** for use on motor, specify motor shaft diameter and add 50c for motor coupling. (Available for 1/4", 5/16", 3/8" and 1/2" shafts.) 50 piece accessory set available $1.50 extra. Order TODAY from

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Manufacturers of Flexible Shaft Equipment for Home and Industry For a Quarter-Century.

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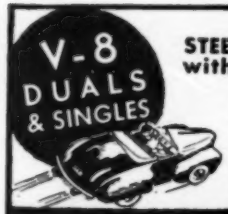

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STEELS and ALUMINUMS with a motorboat tone

SINGLES, Chev, V-8, Plymouth, Steels $5.50, Aluminum $6.50. Chry., Olds., Buicks, etc., Steels $7.50, Aluminum $8.50. V-8 and MERCURY DUALS, Steel $17.50, Aluminum $20.00. Aluminums are guaranteed for life of your car.

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SAVE HANDS SAVE TIME

with Steel-Grip Gloves

The best opportunity for lower costs lies in speeding production. Keep materials moving with Steel-Grip chrome tanned cowhide gloves. Steel ribbons over tough leather strips; palm and fingers reinforced, for utmost wear. Handle rough, heavy, sharp materials with speed and safety and sureness. Or what's your problem? Over 4300 proven Steel-Grip safeguards may give you an *immediate* answer. Used by big industrials since 1910. Write for catalog or state your need today.

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Snap-on Basic ELECTRONIC CONTROL SERVICE TOOL KIT

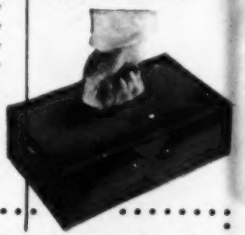
A made-to-order, "tested-on-the-job" kit to service Electronic Controls, Panels, Relays . . . Heat Control Panels . . . Spot Welding Timers . . . Small Hoist Controls . . . and Welding Machine Starters.

. . . cuts "down-time" to a minimum . . . speeds maintenance . . . because you always have the right tool at the right time

This complete 51-pc. kit with Handy Hold-all Box for only **$48.47**

Actually tested in the shops where "down-time" must be held at an absolute minimum, this kit has proved its value over and over again. It contains all the basic tools you will need . . . *and they're Snap-on tools,* built and sized to precision tolerances with the *feel* and *balance* that gives you fast nut-turning efficiency. Check the complete list at the right . . . tear out coupon and mail today.

1 Midget Set 1/4" drive
Including . . . Ratchet, Sliding Tee
Nut Spinner, Flextation
Plastic Grip Handle
Universal Joint
2" and 6" extension
8 Hex. Sockets 5/32" to 7/16"
8 Deep Hex. Sockets 5/32" to 7/16"
3 Square Sockets, 1/4", 5/16", 3/8"
4 Dwarf Boxockets 5/16" to 1/4"
8 Ignition Wrenches 1/32" to 3/8"
1 9 1/4" Screw Starter
Tungsten Ignition File
6" Mill Bastard File
5" Gripper Pliers
6" Diag. Cutter Pliers
6" Needle Nose Pliers
3 Screw Drivers
4" Offset, 1 1/2" and 2 1/2" Stubby, plus a 3" and 4" blade.
1 Red Hold-all Box



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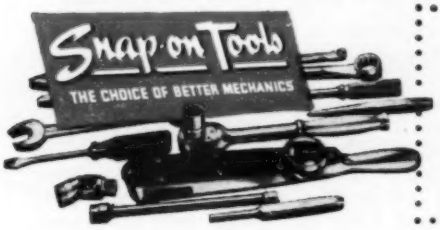
International Division: Kenosha, Wisconsin, U. S. A.



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Power King tools for your home shop — there's a gift the whole family will enjoy for a lifetime! Furniture, cupboards, cabinets, toys . . . anything in wood that your home needs . . . can be made easily and inexpensively with fast Power King tools to help.

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PK tools give you design and construction excellence far beyond their low price. They're rugged, compact, accurate — built for years of smooth service.

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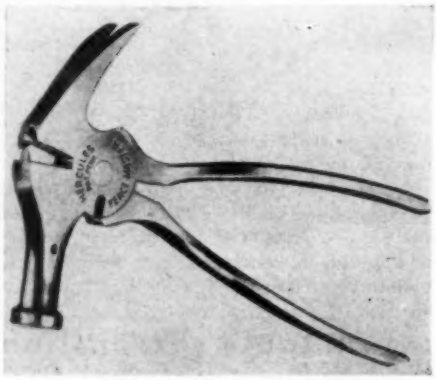
POWER KING TOOL CORP.
1235 Cleveland St.
Warsaw, Indiana

Bike Springs Ease Ride

A FAR cry from the high-wheeled, hard-tired bikes of old, the newest accessory for the comfort of present-day peddlers is a shock absorber for bicycles and motorbikes. Made by the Witherell Co., of Detroit, the double-spring device is easily attached to a bike's front-wheel fork. Its spring action, similar to that of motorcycle shock absorbers, helps cushion rough-road bumps.

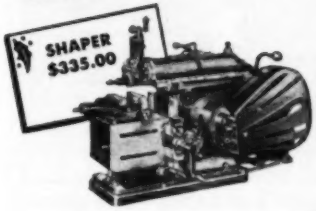


Tool Fills Fence Needs

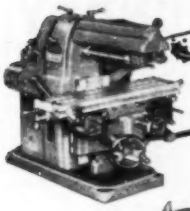
DESIGNED to perform all the jobs of an entire set of fence tools, this single, all-in-one building and repair tool is a combination hammer, ripper and pair of pliers. No larger than a small claw hammer, it splices, cuts and stretches wire, and pulls nails and staples. Made by the Hercules Forge Corp., of Los Angeles, the 10¾-inch-long, nickel-plated fence tool weighs only 1½ pounds.

Merry Christmas TO you FROM you

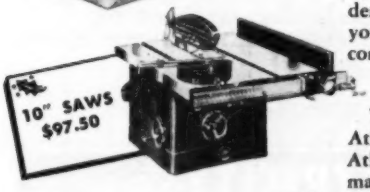
DRILL PRESSES $53.50 and up



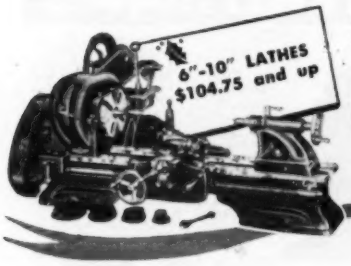
SHAPER $335.00



MILLING MACHINES $285.00 and up



10" SAWS $97.50



6"-10" LATHES $104.75 and up

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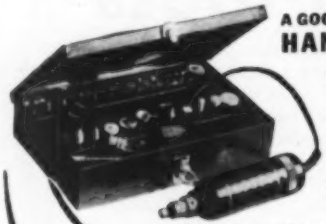

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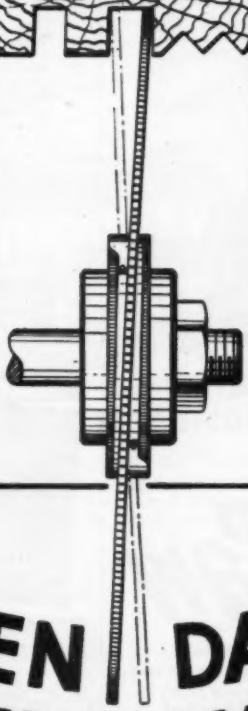

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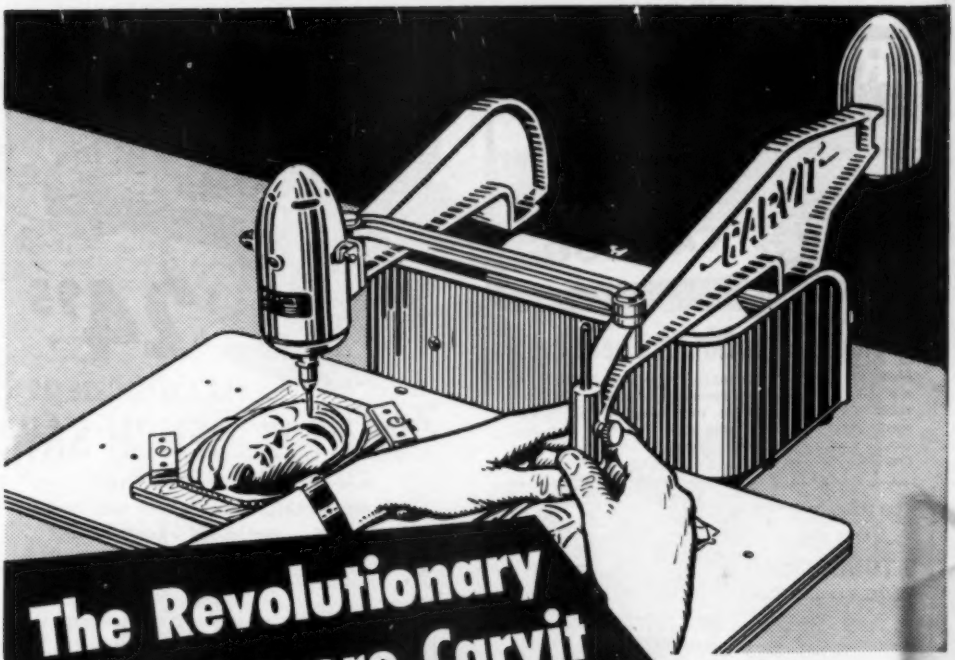

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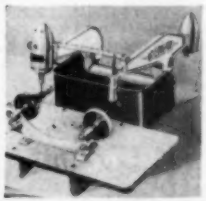

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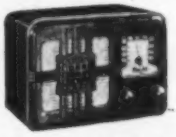

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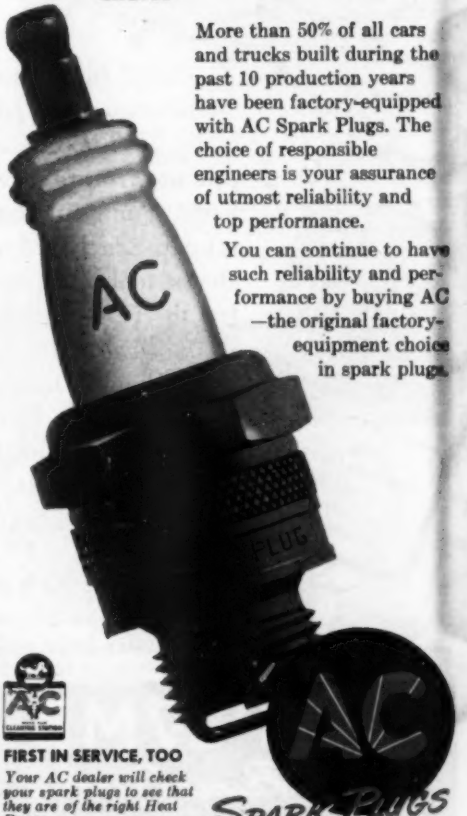

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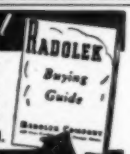

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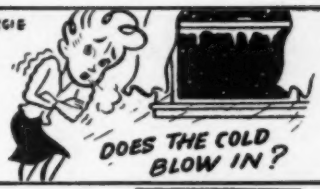

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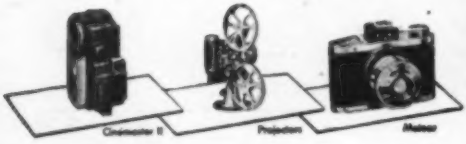

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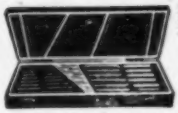

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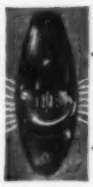

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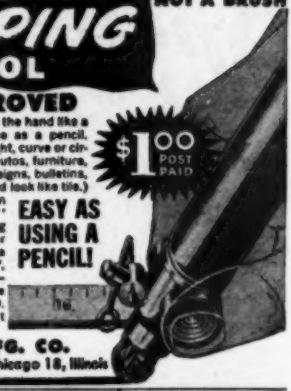

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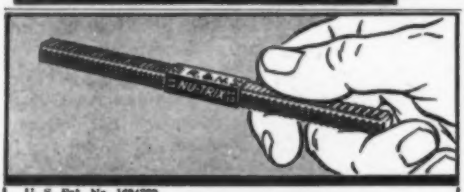

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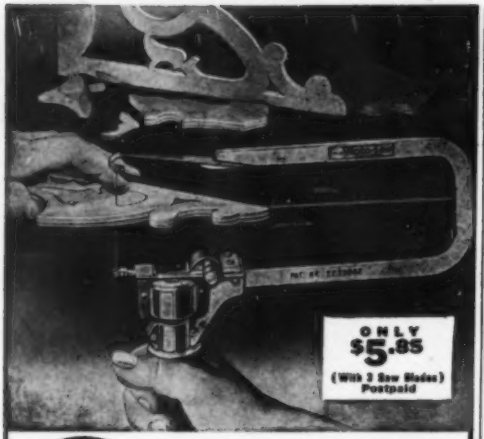

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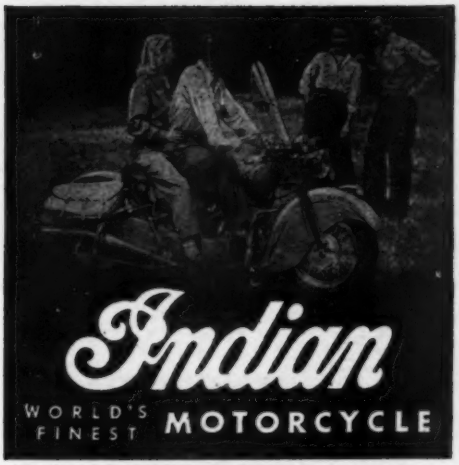

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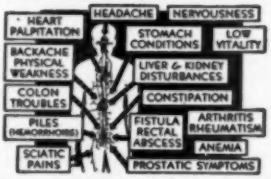

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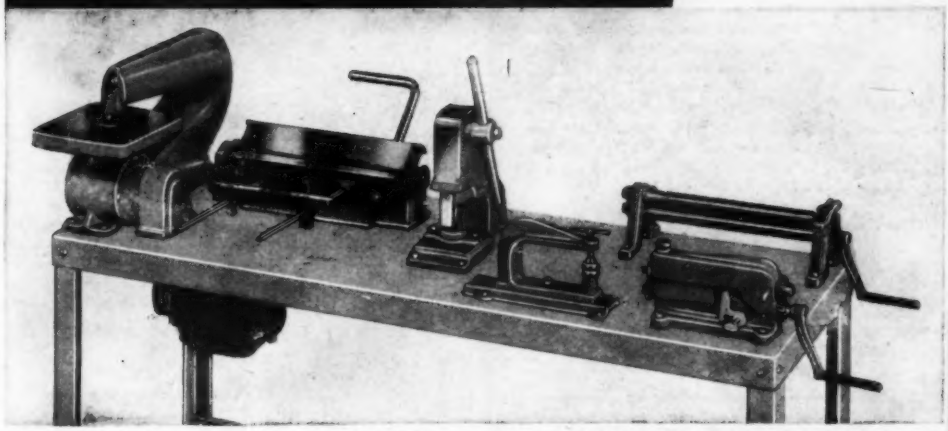

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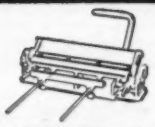

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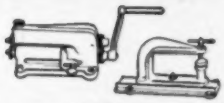

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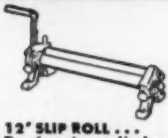

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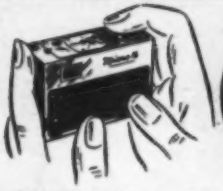

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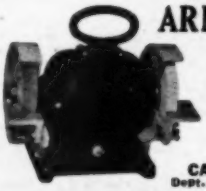

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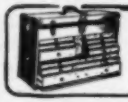

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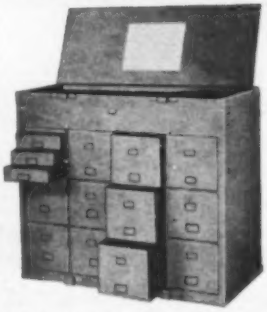

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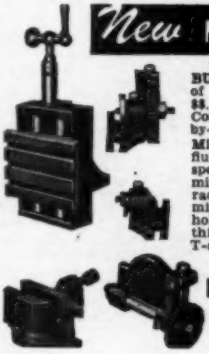

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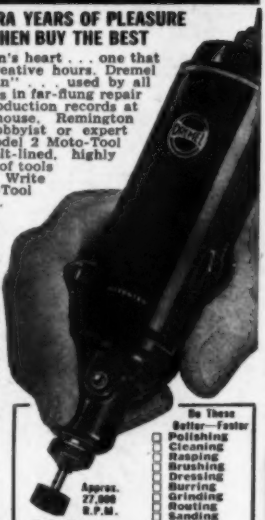

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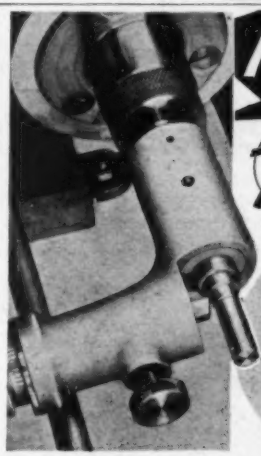

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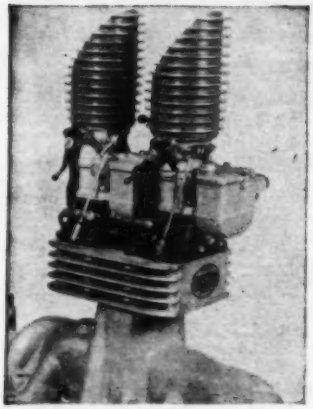

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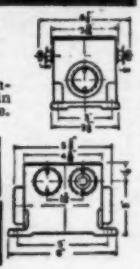

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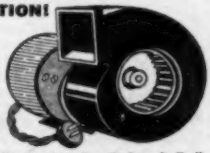

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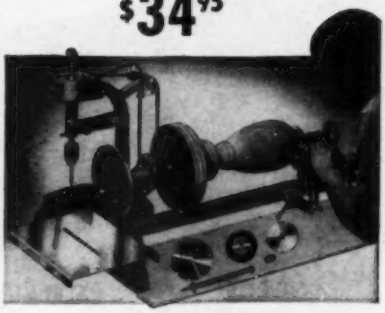

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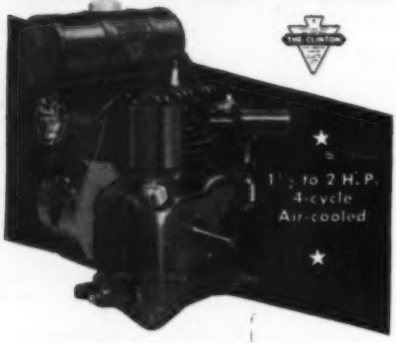

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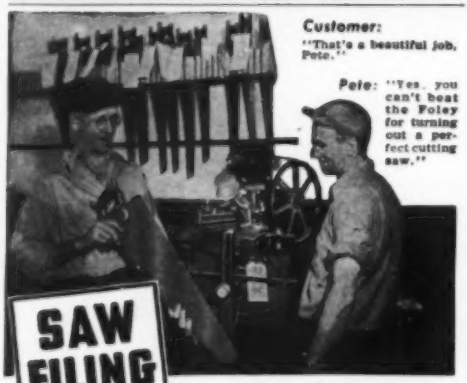

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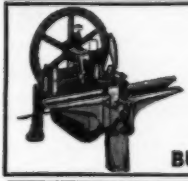

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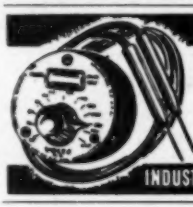

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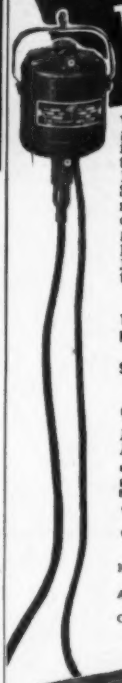

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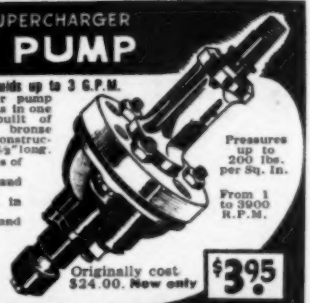

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Here is THE precision tool that every man who works with wood just can't afford to be without. The REDFORD is a shaper, planer, sander—all in one—*at a price never before thought possible.* It is portable (weighs only 12½ pounds) takes any standard cutter, planer or sander that fits a ½-inch spindle. Power-driven from a 1/3 H.P. electric motor (not furnished) or it may be bolted to a drill press table and driven direct from drill press chuck.

Illustrated folder explains in detail ALL of the many NEW FEATURES and advantages. Nothing else compares with its versatility—or LOW COST.

Send for FREE Illustrated FOLDER

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REDFORD SPECIALTIES INC.
18437 Salem • Detroit 19, Mich.

Assemble KING MIDGET

Practical highway racer runabout. We supply all parts. Just bolt together. Low cost. Ready for delivery NOW. One or two cylinder 40 m.p.h., 45 to 50 on ice or snow with skiis, up to 100 miles per gallon. Send 25c for complete literature with large picture, 4-view drawings, price of parts, or send $1 (refunded with first order) for the above, plus 24-page assembly book with 42 photographs and drawings; blueprints for converting for use on ice and snow, etc.

MIDGET MOTORS Athens, Ohio

"MAKES ARITHMETIC INTERESTING"

PATENT PENDING

The AMAZING CHINESE ABACUS which a Japanese contestant used in Tokyo to outspeed the Electric Calculator!
Now made in the U. S. A. with complete instructions.
Naturally! LOY'S IMPROVED ABACUS is easier to use and more accurate to calculate than the old Chinese Abacus.
Easy to add, subtract, multiply, and divide without using paper and pencil.
Use it at the store for all calculations . . . adding, checking bills and bookkeeping. Use it at home to make arithmetic more interesting for your children.
The beautifully finished Abacus and specially illustrated book all for $8.50.
Send for yours today with money order or C.O.D.

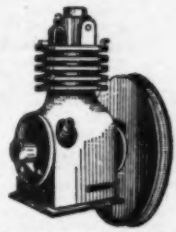
LOY'S CHINESE CALCULATOR
1317 Rhode Island Ave., N.E. Washington 18, D. C.

Attention retailers: be the first in your community to sell this sensational item.

ELECTRIC MOTORS
AIR COMPRESSORS

Guaranteed capacitor ball bearing heavy duty motors, 110/220 volts 60 CYCLE AC SINGLE PHASE 1725 RPM.

¼ HP .....$24.00 Wt. 30 lbs.
½ HP .....$34.50 Wt. 36 lbs.
¾ HP .....$44.00 Wt. 50 lbs.
1 HP .....$57.00 Wt. 80 lbs.



Air compressor, piston type, size 2 x 1¾, head in valves, bronze bearings splash lubrication. Capacity 2.8 c.f.m. at 100 lbs. continuous pressure or 150 lbs. intermittent, with ½ HP motor. Can be used with ¼ HP or ⅓ HP at lower pressures. Price $18.75. Wt. 24 lbs.

Only $16.50

6 ft. Stow Flexible Shaft, Heavy Duty, ⅜" Core. Best piano wire. Ball bearing handle and arbor, rubber covered housing; for ½" motor shaft; for ½" bore wheels. Operates on ¼ H.P. Motor at 1725 or 3450 R.P.M. $29.00 Value, only $16.50. Wt. 8 lbs.

Special Price in Larger Lots

1/30 HP 24 volt DC motor 2450 RPM. ¼" shaft. Price $2.45. Wt. 4 lbs. Size 3" x 4". Write for special price in lots of 100 or more.

DELCO *Light Plants*

Portable 3 KW 110 volt DC with 6 HP Wisconsin or Briggs and Stratton air cooled engine, voltmeter with four outlets, 150 ft. rubber covered cord and plugs. Slightly used like new. $375.00 value—special $115.00. Wt. 350 lbs. crated.

500 Ingersoll-Rand riveters and shipping hammer. Model AVC-11, like new. Takes up to 5/32" rivet. $66.00 list. Special price $6.95. Wt. 5 lbs.

Prices quoted are F.O.B. Chicago, Illinois, offered for immediate delivery and shipment. We reserve the right to limit quantity. Send check or money order. Sold with money back guarantee.

C & M EQUIPMENT COMPANY
1831 S. STATE ST., DEPT. D-12 CHICAGO 16, ILL.

$1 SOLID BRASS STEEL BLADES

4 in 1 SCREWDRIVER

Four different sized screwdrivers all fitted into one handy tool. Large enough for autos, small enough for watches. Dad and son will both want one. Mom will want these four vari-sized screwdrivers too for their many practical home uses. Also makes a good gift! **Agents wanted, exclusive territory, liberal discount.** Check or money order.

ELK MERCHANDISING CO., S12
2348 N. Western Ave. Chicago 47, Ill.

LABORATORY MICROSCOPE
600 POWER $22.50

3 Objectives—75X, 300X, 600X
A professional type microscope priced within the reach of the amateur. For school, laboratory, physician, and student. Color corrected achromatic lenses. Professional size eyepiece and objective interchangeable with all standard professional makes. Height 14 inches. Weight 5¼ lbs. Stage 4"x4". 3 wheel focusing. Body tilts any angle. Microscope complete with 3 objectives, prepared specimen slide, and 96 page book on microscopy, only $22.50.

We pay the postage. Immediate delivery. Money back guarantee.

BROWNSCOPE CO.
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WORLD'S LOWEST PRICED ADDING MACHINE

VEST POCKET SIZE

NEW!

Fits vest pocket or purse. Guaranteed accurate. Operated as easily, and as reliable, as machines costing many times as much. NOT A TOY OR GADGET. Precision made—very durable. Guaranteed for life against defects in construction. Beautiful looking, modernized design. Finished in silver with black numbers and red slides. You positively can't buy a Calculator of equal quality for as little money. ACCEPTED AS THE FINEST LOW PRICED CALCULATOR FOR OVER 35 YEARS! Now completely redesigned and improved. **BETTER THAN EVER BEFORE!** Operates with a flick of your finger. Adds, subtracts, multiplies, divides—counts up to one billion. Pays for itself over and over in mistakes avoided and time saved.

MAKES IDEAL GIFT

Baby Calculator makes an ideal gift—for every Gift occasion, Birthday — Graduation — Christmas — Anniversaries. For men, women, children, teachers, business people, home or shop use. **COMES PACKED READY FOR GIFT WRAPPING.**

TEN DAY TRIAL

Money Back Guarantee

Because we know that our machine is the very best Calculator to be obtained at this low price, we make this 10 Day Trial Offer on a positive money back guarantee! Don't buy ANY Calculator without this guarantee! Send only name and address, pay postman $2.95 plus postage (if cash is sent, we pay postage—you save up to 40c). (Send full cash if outside U. S.) Money back within 10 days if not delighted.

IDEAL XMAS GIFT

FREE TRIAL

ONLY **$2.95** TOTAL COST

SEND NO MONEY

CALCULATOR MACHINE CO. (Mfrs.)

Dept. 485, P. O. Box 248, GLENVIEW, ILL.

AGENTS WANTED

USE COUPON

CALCULATOR MACHINE CO., (Mfrs.)
Dept. 485, P. O. Box 248, Glenview, Ill.
Your Calculator is just what I've been looking for. Send one at once (C.O.D.) or (I am enclosing $2.95).

Name.....

Address.....

City.....State.....

FREE!!

Each Baby Calculator enclosed in beautiful, rich-looking simulated Leather Case—at no extra cost.

NEW PLASTICS FUN KIT

HERE is your package of Christmas fun—hours of enjoyment building beautiful plastic jewelry, novelties and household articles! **FUN KIT** gives you everything you need to build 8 attractive plastics projects; tools, materials, instructions and plans includes approx. 1 lb. clear sheet plastic, 4-piece assorted plastic rods, coping saw, 2 sanding blocks and paper, 2 buffing pads, eye dropper, brush, scriber, ruler, jar each of dye, cement and wax, and blue print instructions for 8 plastics projects (utility tray, photo holder, bracelet, picture frame, letter opener, bill file, Christmas ornament, letter holder). Order **FUN KIT** today! **$2.95** ea. plus 10% postage and shipping, or sent C.O.D. Write for our new catalog.

HOUSE OF PLASTICS

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THE GIFT FOR A MAN'S CHRISTMAS!

The KOTTERPULLER

Gets out the most stubborn cotterpins, quick and easy. For auto and aviation mechanics, garage men, shop men, farmers, hobbyists and anyone who works with tools.

DEALERS WANTED

Send Check or Money Order Today

The DORHONS Co.

3131 WEST 30th STREET • DEPT. 1
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IF IT'S MADE BY LIONEL, YOU CAN GET IT AT MADISON HARDWARE

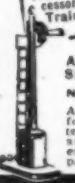
NEW LIONEL GG-1 PENN. Electric-Type LOCO

$32.50

No. 2332

A masterpiece of scale detailing! Designed for third-rail operation; can easily be adjusted for pantograph current pick-up from overhead wires. The 2 pantographs can be raised or lowered. 20-wheel drive, realistic horn.

Madison has been World Headquarters for Lionel since 1909. We offer a complete line of Lionel Train Sets, Cars, and Accessories. Write for big Train folder—it's FREE



AUTOMATIC SEMAPHORE

No. 151 . . . $4.95

Another new touch for your Lionel system! Semaphore arm automatically operates when train passes.

PENNSYLVANIA STEAM-TYPE LOCO WITH SMOKE AND WHISTLE TENDER

No. 675LTS

SEND US YOUR LIONEL REPAIRS

Here's realism. Rugged, powerful! Smoke synchronized with driving mechanism; puffs when in motion. 10 wheels.

"0" gauge **$25.00** "027" gauge **$24.50**

We pay postage on cash orders. C.O.D.'s accepted.

MADISON HARDWARE CO., 103 E. 23rd St., New York 10

Please ship
Quantity . . . GG-1 Penn. Loco @ **$32.50** ea.
. . . Automatic Semaphore @ **$4.95** ea.
PS . . . 675LTS Loco ☐ "0" gauge @ **$25.00** ea.
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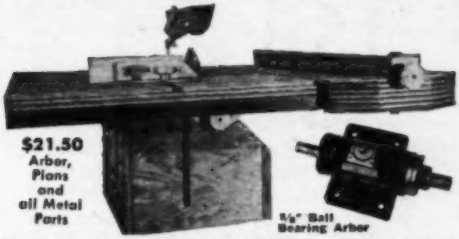
MADISON HARDWARE CO., 103 EAST 23rd ST., N. Y. 10, N. Y.

BUILD IT YOURSELF



8" TILTING TABLE SAW

With our easy to follow step-by-step plans and instructions, you can build it with ordinary hand tools for a fraction the cost of all metal saws of comparable size and capacity. Sturdy wood, steel and aluminum construction.

FEATURES—Big roomy top 27" x 32" with 13½" clearance ahead of saw. Tilts to 45°.

Precision built ball bearing arbor lubricated and sealed. No further lubrication required.

Self aligning, full strength rip fence. Indexed mitre gauge. Indexed table tilting quadrant. Adjustable saw arm—cuts from 0" to 2¼".

In California add 2½% sales tax

COMPLETE KIT—Includes **Ball Bearing Arbor** with Saw Plans and instructions, and all metal parts, bolts, washers and screws (less saw blade)	$21.50
¾" **Ball Bearing Arbor only**—with Saw Plans and instructions	$ 6.95
Metal Parts only—less Arbor with Saw Plans and instructions	$14.55
Complete plans only	$ 1.00

If your dealer cannot supply you, send check or money order—we will ship promptly postpaid in U.S.A. or possessions.

Dealer inquiries invited

WILLIAM H. CRANDALL COMPANY

1009 Fruitvale Avenue—Dept. P—Oakland 1, California

Ideal gift for "him!" Never before was so much usefulness packed into a single hand tool. ***Gives one hand TON-GRIP. *Locks to the work. *Remains locked with hands removed.** And, now, complete with:

THIN NOSE Permits working in extremely close quarters.

NEW INVOLUTE JAW CURVE (1) Jaws can apply tremendous pressure on 4 points of any size nut. (2) Increases tooth-contact on round work, giving a mighty, non-slip grip. Holds round work up to 1⅞" diameter. Better than a pipe wrench. (3) As a clamp, pressure can be applied exactly where wanted.

WIRE CUTTER Ton-pressure cuts wire and small bolts. Actually cuts ¼" bolts by taking progressive bites.

KNURLED JAW TIPS Holds work at the very tip.

Easy to open. Made of fine alloy steel. Nickel plated. Two sizes—7" and 10"—with or without wire cutter.

GET YOURS NOW! See your dealer. With Cutter—7", $2.25; 10", $2.50. Without Cutter—7", $1.85, 10", $2.25.

PETERSEN MFG. CO., Dept. 38 DeWITT, NEBR.

New 22-piece CASCO Power Workshop puts 1001 Skills at your Fingertips

It Engraves!
It Cleans!
It Polishes!
It Cuts!
It Grinds!
It Carves!
It Saws!
It Sands!
It Buffs!
It Etches!
It Drills!
It Brushes!

Here's what every hobbyist, home craftsman and mechanic has been waiting for! A high-speed Power Tool that's actually a complete, portable workshop! Each of its 20 precision made accessories can be instantly attached—transforming the tool into a dozen separate tools. Can be used on wood, metal, glass, plastic or other materials. Comes complete in a sturdy leatherette case. Handles like a pencil—is air-cooled.

The extra powerful, 20,000 RPM Tool plugs into any AC-DC socket. Has exclusive finger grip which permits closer work. Shockproof, unbreakable Tenite case; chrome fittings; on-off switch for one-hand operation; vibrationless high speed. Quiet, smooth-running, efficient.

HERE'S WHAT YOU GET

1 Rubber Polishing Wheel • One ⅛" Speed Drill • One ⅛" Ball Cutter • Sturdy Leatherette Case • Valuable Project Booklet • 3 Bristle Brushes • 2 Abrasive Separating Discs • 3 Mandrels • 1 Felt Wheel • 2 Collets • 1 Dressing Stick • 1 Wrench • 4 Emery Wheels • *PLUS* AC-DC Electric POWER TOOL. At leading stores everywhere!

CASCO

Another good buy—Casco-Electri-Craft Kit—has 36 accessories and steel storage chest—$32.95 if purchased separately—an outstanding value at only $22.50.

YOU DO BETTER WORK WITH A BETTER TOOL

CASCO PRODUCTS CORPORATION • BRIDGEPORT 2, CONN.

TO: Reader
FROM: Editor

One Man's Meat

A DECENT interval after this issue reaches subscribers, about a thousand interested readers will sit down to fill out a question form they have received. On this long, detailed questionnaire they will check their readership of every major article and department in the magazine. And they will tell us what they liked best, how old they are, what kind of job they hold. They will do all this on their own time, under no compulsion, simply because they want to.

A few—a very few—will indulge themselves with anonymous wisecracks. But far more will volunteer helpful comments.

Some Are Sour

Not all of these remarks will be favorable. Some will be sincere and sour. These hurt, but we like to get honest opinions. Then there are the readers who say, "Give us more photography articles—or more woodworking." One wants bigger workshop projects; another pleads for simpler jobs that don't call for power tools.

Last month I got two beauties—oh, yes indeed I get them; every questionnaire with comments is automatically sent direct to my desk. These two readers unwittingly represented the north and south poles of the same little world that is PSM. One wrote: "would like to see more articles on the important developments in science; too many shop articles." The other answered: "serious stuff okay, but why not more dope on new cars and tools? Want more metalworking." The occupations were the tip-off—one was a college student, the other a refrigerator welder.

An editor is really just a cook in a print shop. It's his job to serve what people will want when they see it on the menu. Aside from being a professional magazine cook, perhaps my best recommendation for this job at PSM is that I used to eat here myself—and still do. As a regular reader, sitting out front, I enjoyed the magazine for years. Back here in the kitchen, ordering the supplies, watching the ideas as they are boiled into articles and pictures, tasting constantly every dish on the menu of the month, I sometimes wonder if anything will be good when the crowd sits down.

Proof of the Pudding

Then the printers dish up the first proofs, and I sit down myself to eat the issue. Sometimes I start at the front and read straight through. Or start at the back and flip from one high spot to another.

But usually I go through the magazine looking at pictures, reading headlines and captions. Knowing the words (because I read most of them when they were still only typewriting on yellow paper), I am always a little amazed at how much you can get out of PSM without even reading it.

Tattletale Mail

Anyway, when the votes from readers come in I'm anxious to find out how *they* liked the things *I* liked on the menu. Usually the articles we think are interesting enough to get the most space are what you like best. But every issue there are a couple of surprises—articles that turn out to be more popular than we expected. And where there are winners there are always losers—some of our little favorites make crash landings in the reader polls.

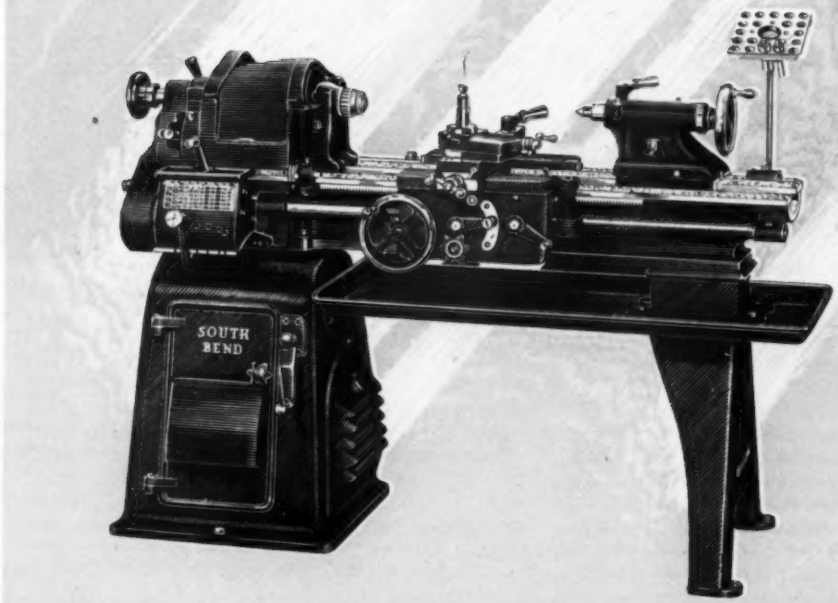
Maybe you've never received a ballot. Or maybe you buy your PSM at a newsstand, as I used to before I got free copies. If so, you never get a ballot.

In any case, *if you'd like to chip in your two cents worth,* send me a penny post card. Just address it: GITHENS, PSM, 353 FOURTH AVE., NEW YORK 10, N. Y. Write your name and address, and the letter "B." I'll see that you get a ballot. And you can be sure we'll all be glad to get your opinion on the articles in this issue.

PG

SOUTH BEND

Precision Lathes



The South Bend Precision Lathes and Lathe Attachments shown on the following pages are the result of forty years of experience in building fine lathes. The workmanship and materials entering into their construction are the best that can be obtained and the highest standards of accuracy are maintained throughout their manufacture.

SOUTH BEND LATHE WORKS

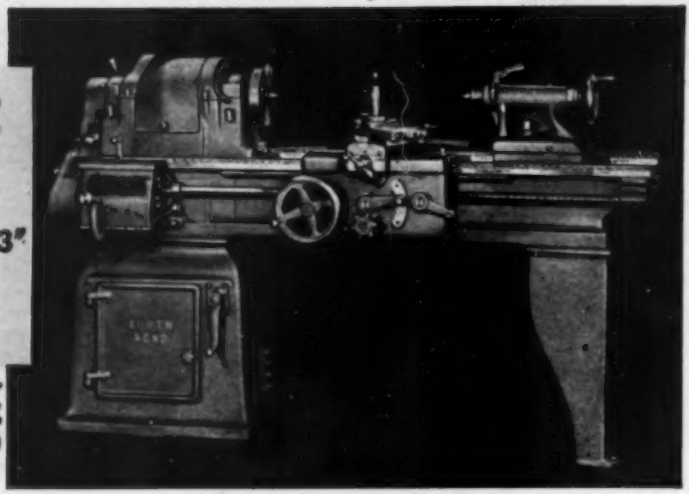
BUILDING BETTER LATHES SINCE 1906 • 524 E. MADISON STREET • SOUTH BEND 22, INDIANA, U.S.A.
CABLE ADDRESS "*TWINS*" SOUTH BEND
ESTABLISHED 1906
INCORPORATED 1914

PROMPT DELIVERY
Quick deliveries can now be made from distributor's stock in all principal cities, or from factory. For name of distributor see "Machine Tools" in classified section of phone book. If there is no distributor near you, send your orders and inquiries direct to the factory.

PRICES
Prices of South Bend Lathes are reasonable, the average increase over pre-war level being less than 15%. All prices are net f.o.b. factory, crated for domestic shipment.

SOUTH BEND

16", 14½", and 13" Quick Change Gear Lathes



South Bend 16" x 6' Quick Change Gear Lathe
$1640.50

SPECIFICATIONS	16-INCH	14½-INCH	13-INCH
Swing over bed and saddle wings	16¼"	14⅝"	13⅛"
Swing over saddle, chip guard removed	11⅛"	10¼"	8¾"
Swing over saddle with chip guard	9⅝"	8¾"	7¾"
Spindle speeds	21 to 725 r.p.m.	27 to 800 r.p.m.	34 to 875 r.p.m.
Thread cutting range	4 to 224 R.H. or L.H.	4 to 224 R.H. or L.H.	4 to 224 R.H. or L.H.
Power longitudinal feeds	.0015" to .0841"	.0015" to .0841"	.0015" to .0841"
Power cross-feeds	.0006" to .0312"	.0006" to .0312"	.0006" to .0312"
Hole thru spindle	1⅜"	1⅛"	1"
Collet capacity	1"	¾"	11/16"
Spindle centers	No. 3 Morse Taper	No. 3 Morse Taper	No. 3 Morse Taper
Size motor	1½ h.p.	1½ h.p.	1 h.p.

South Bend Quick Change Gear Lathes are equally efficient on precision toolroom work or close tolerance manufacturing operations. Hundreds of nationally known manufacturers select them when streamlining their shop equipment to meet present day needs. Substantial savings in capital investment, power consumption, floor space, and labor costs have resulted from their installation. They will give you the same efficient service.

The Underneath Motor Drive provides an unusually wide range of spindle speeds. The belt drive to the spindle is silent in operation and develops smooth, steady power entirely free from gear vibration.

Price includes 3 ph., 60 cy., 220 v. A.C. motor and drum control, and regular lathe equipment such as belts, centers, face plates, tool post, etc. Chucks and tools are extra. See following pages.

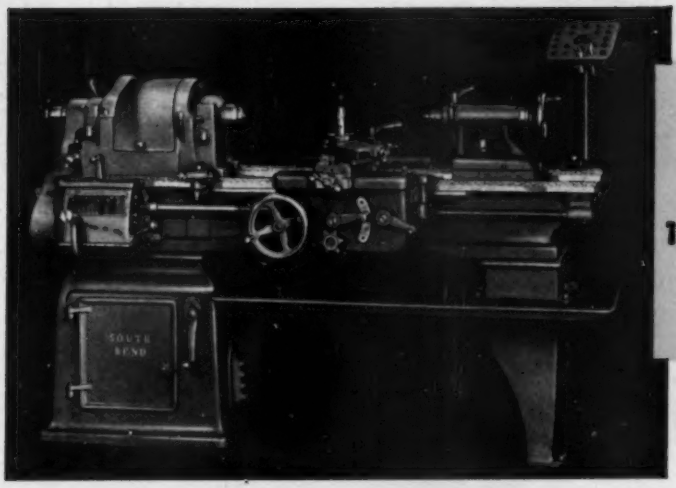
TIME PAYMENT PLAN

25 per cent down
12 months to pay balance
moderate finance charges

Quick Change Gear Underneath Motor Driven Lathes

Catalog Number	Swing Over Bed Inches	Length of Bed Feet	Distance Between Centers Inches	Approx. Shipping Weight Pounds	Price f.o.b. Factory
16" QUICK CHANGE GEAR LATHES					
117-C	16¼	6	33½	2300	$1640.50
117-D	16¼	7	45½	2380	1678.50
117-E	16¼	8	57½	2460	1716.50
117-G	16¼	10	81½	2620	1826.50
117-H	16¼	12	105½	2850	1936.50
14½" QUICK CHANGE GEAR LATHES					
183-B	14⅝	5	24½	1995	$1382.50
183-C	14⅝	6	36½	2070	1420.50
183-D	14⅝	7	48½	2145	1458.50
183-E	14⅝	8	60½	2225	1496.50
13" QUICK CHANGE GEAR LATHES					
113-A	13⅛	4	16	1460	$1117.50
113-B	13⅛	5	28	1510	1153.50
113-C	13⅛	6	40	1560	1189.50
113-D	13⅛	7	52	1615	1225.50

SOUTH BEND LATHE WORKS, 524 E. Madison Street, South Bend 22, Indiana, U.S.A.



SOUTH BEND

16", 14½", and 13" Toolroom Lathes

South Bend 16" x 6' Toolroom Lathe
$2031.50

SPECIFICATIONS	16-INCH	14½-INCH	13-INCH
Swing over bed and saddle wings...	16¼"	14⅝"	13⅛"
Swing over saddle cross slide.....	9⅝"	8-15/16"	8"
Spindle speeds.....	21 to 725 r.p.m.	27 to 800 r.p.m.	34 to 875 r.p.m.
Thread cutting range.....	4 to 224 R.H. or L.H.	4 to 224 R.H. or L.H.	4 to 224 R.H. or L.H.
Power longitudinal feeds.....	.0015" to .0841"	.0015" to .0841"	.0015" to .0841"
Power cross-feeds.....	.0006" to .0312"	.0006" to .0312"	.0006" to .0312"
Hole thru spindle.....	1⅜"	1⅛"	1"
Collet capacity.....	1"	⅞"	11/16"
Spindle centers.....	No. 3 Morse Taper	No. 3 Morse Taper	No. 3 Morse Taper
Size motor.....	1½ h.p.	1½ h.p.	1 h.p.

Toolroom Underneath Motor Driven Lathes

Catalog Number	Swing Over Bed Inches	Length of Bed Feet	Distance Between Centers Inches	Approx. Shipping Weight Pounds	Price f.o.b. Factory
16-INCH TOOLROOM UNDERNEATH BELT MOTOR DRIVEN LATHES					
8117-C	16¼	6	33½	2525	$2031.50
8117-D	16¼	7	45½	2605	2075.50
8117-E	16¼	8	57½	2685	2119.50
14½-INCH TOOLROOM UNDERNEATH BELT MOTOR DRIVEN LATHES					
8183-B	14⅝	5	24½	2180	$1735.50
8183-C	14⅝	6	36½	2255	1778.50
8183-D	14⅝	7	48½	2330	1821.50
8183-E	14⅝	8	60½	2405	1863.50
13-INCH TOOLROOM UNDERNEATH BELT MOTOR DRIVEN LATHES					
8113-B	13⅛	5	28	1665	$1481.50
8113-C	13⅛	6	40	1715	1519.50
8113-D	13⅛	7	52	1770	1557.50

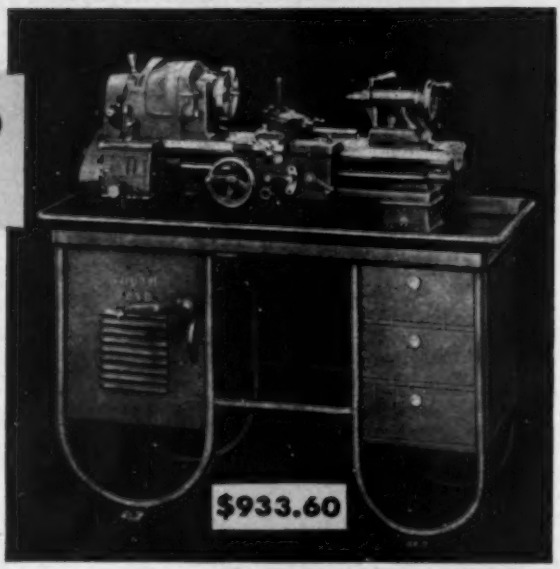
South Bend Toolroom Lathes are equally efficient on precision toolroom work or close tolerance manufacturing operations. Their versatility reduces set-up time to a minimum. Smooth, vibration-free operation permits finish turning or boring with such precision that subsequent machine operations can often be eliminated. A convenient arrangement of controls makes for an ease of operation which reduces fatigue and lowers the probability of error. A wide range of spindle speeds permits machining work with maximum tool efficiency.

Improved Features include: alloy steel headstock spindle; replaceable headstock bearings; double wall apron; quick change gear box for threads and feeds; and semi-steel lathe bed.

In Addition to 3-ph., 60 cy., 220 v., A.C. motor and drum control, and all equipment supplied with quick change gear lathe (see preceding page) the following toolroom attachments are included in price of lathe: handwheel type draw-in collet chuck attachment; collet rack; telescopic taper attachment; thread dial indicator; chip pan, and micrometer carriage stop. Chucks, tools, and collets are extra.

SOUTH BEND LATHE WORKS, 524 E. Madison Street, South Bend 22, Indiana, U.S.A.

South Bend 10" x 3', 1" Collet Quick Change Gear Bench Lathe



SOUTH BEND

10"-1" Collet Lathes

SPECIFICATIONS

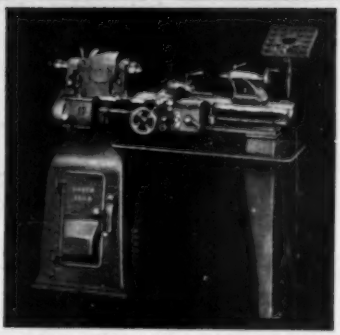
Swing over bed and saddle wings.....10½"
Swing over saddle cross slide.....8¾"
Spindle speeds (12).....50 to 1357 r.p.m.
Thread cutting range....4 to 224 R.H. or L.H.
Power longitudinal feeds.... .0015" to .0836"
Power cross-feeds..... .0006" to .0309"
Hole thru spindle.....1⅜"
Collet capacity.....1"
Spindle centers.....No. 2 Morse Taper
Cross slide travel.....3⅞"
Compound rest top slide travel.....2"
Size motor.....¾ h.p.

10-inch Swing South Bend Precision Lathes are capable of the most exacting operations on both tool and production work. This accuracy, together with their speed and versatility, contribute to lower machining costs. They contain all the design features that make the larger models so dependable.

Price includes 3 ph., 60 cy., 220 v., A.C. motor; drum control, and regular lathe equipment such as belts, centers, face plates, tool post, etc. Chucks and tools are extra. Toolroom Lathes also include: handwheel type draw-in collet attachment (without collets); collet rack; telescopic taper attachment; thread dial indicator; and micrometer carriage stop. Bench is included in price of bench lathe.

TIME PAYMENT TERMS

25 per cent down 12 months to pay balance moderate finance charges



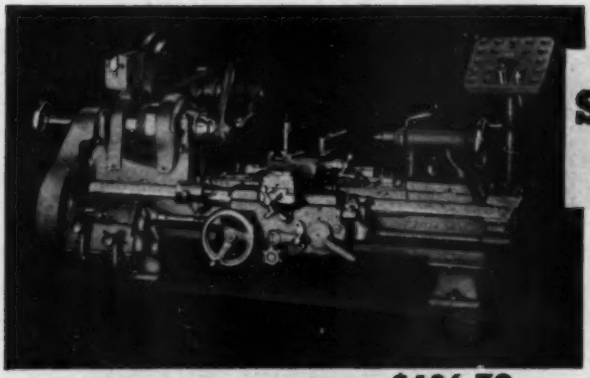
South Bend 10" x 3½', 1" Collet Toolroom Lathe **$1168.60**

10"-1" Collet Quick Change Gear and Toolroom Lathes

Catalog Number	Swing Over Bed Inches	Length of Bed Feet	Between Centers Inches	Shipping Weight Pounds	Price f.o.b. Factory
QUICK CHANGE GEAR BENCH LATHES					
187-TS	10½	3	15¾	850	$933.60
187-ZS	10½	3½	20¾	880	949.60
187-AS	10½	4	26¾	950	975.60
187-RS	10½	4½	33¾	980	998.60
QUICK CHANGE GEAR LATHES WITH FLOOR LEGS					
187-Y	10½	3	15¾	810	$863.60
187-Z	10½	3½	20¾	835	879.60
187-A	10½	4	26¾	860	895.60
187-R	10½	4½	33¾	885	918.60

Catalog Number	Swing Over Bed Inches	Length of Bed Feet	Between Centers Inches	Shipping Weight Pounds	Price f.o.b. Factory
TOOLROOM BENCH LATHES					
8187-TS	10½	3	15¾	960	$1196.60
8187-ZS	10½	3½	20¾	990	1212.60
8187-AS	10½	4	26¾	1060	1238.60
TOOLROOM LATHES WITH FLOOR LEGS					
8187-Y	10½	3	15¾	935	$1151.60
8187-Z	10½	3½	20¾	960	1168.60
8187-A	10½	4	26¾	985	1185.60

SOUTH BEND LATHE WORKS, 524 E. Madison Street, South Bend 22, Indiana, U.S.A.



South Bend 9" x 3' Toolroom Bench Lathe **$486.70**

$167.20

South Bend 9" x 3' Model C Bench Lathe

SOUTH BEND

9-Inch Bench Lathes

SPECIFICATIONS

Swing over saddle wings.....9¼"
Swing over chip guard.....5½"
Spindle speeds:
6 speed drive.....41 to 658 r.p.m.
12 speed drive.....41 to 1270 r.p.m.
Thread cutting range:
Model A.....48 pitches R.H. or L.H. 4 to 224 per inch
Models B & C...45 pitches R.H. or L.H. 4 to 160 per inch
Power longitudinal feeds:
Model A.....48—.0015" to .0853"
Model B.....26—.0021" to .0155"
Model C.....14—.0031" to .0156"
Power cross feeds:
Model A.....48—.0004" to .0252"
Model B.....23—.001" to .0046"
Belt, width of pulley step for.....1"
Centers, Morse taper.....No. 2
Collet capacity, maximum.....½"
Headstock spindle hole.....¾"
Lead screw 29" Acme Thread.....⅜"—6
Motor, size required:
For 6-speed drive.....⅛ h.p.
For 12-speed drive.....½ h.p.
Spindle nose threads.....1½"—8
Tailstock top set over.....⅛"
Tool holder cutter bit.....¼" sq.
Tool holder shank.....⅜" x 13/16"
Approx. shipping weights:
3 ft. bed lathe.....355 lbs.
3½ ft. bed lathe.....380 lbs.
4 ft. bed lathe.....405 lbs.
4½ ft. bed lathe.....430 lbs.

Model A 9-inch Lathes have heat-treated alloy steel spindle, quick change gear box, and friction clutch worm drive for power longitudinal feeds and power cross-feeds.

Model B 9-inch Lathes are same as Model A Lathes except that they have independent change gears, instead of the quick change gear box, for threads and feeds.

Model C 9-inch Lathes are same as Model B Lathes except they do not have the worm drive for power feeds. The cross-feed is hand-operated, and longitudinal feeds are obtained by engaging half-nuts with the lead screw.

Toolroom 9-inch Lathes are same as Model A Lathes except that they have the following toolroom attachments: collet chuck; collet rack; taper attachment; thread dial; and micrometer carriage stop.

Price includes 1 ph., 60 cy., 115 v., A.C. motor, drum control, and regular lathe equipment such as belts, centers, small face plate, tool post, etc. Chucks, collets, and tools are extra.

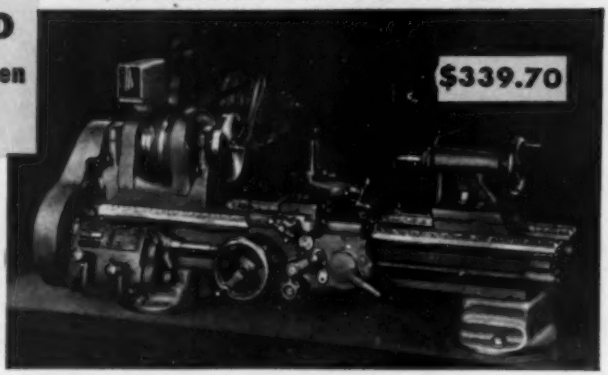
9-Inch Swing Horizontal Motor Driven South Bend Precision Bench Lathes

Length Bed Feet	Between Centers Inches	9" TOOLROOM LATHES		9" MODEL A LATHES				9" MODEL B LATHES				9" MODEL C LATHES			
				6-speed drive		12-speed drive		6-speed drive		12-speed drive		6-speed drive		12-speed drive	
	Inches	Cat. No.	Price	Cat. No.	Price	Cat. No.	Price	Cat. No.	Price	Cat. No.	Price	Cat. No.	Price	Cat. No.	Price
3	16	8644-Y	$486.70	444-Y	$272.20	644-Y	$317.70	477-Y	$217.20	677-Y	$262.70	415-YC	$167.20	615-YC	$212.70
3½	22	8644-Z	501.70	444-Z	287.20	644-Z	332.70	477-Z	232.20	677-Z	277.70	415-ZC	182.20	615-ZC	227.70
4	28	8644-A	516.70	444-A	302.20	644-A	347.70	477-A	247.20	677-A	292.70	415-AC	197.20	615-AC	242.70
4½	34	.....	.....	444-R	324.20	644-R	369.70	477-R	269.20	677-R	314.70	415-RC	219.20	615-RC	264.70

SOUTH BEND LATHE WORKS, 524 E. Madison Street, South Bend 22, Indiana, U.S.A.

9" SOUTH BEND
V-Belt Horizontal Motor Driven Bench Lathes

9"x3' Model A Bench Lathe with 16-Speed V-Belt Drive



The 9" Bench Lathes with 8-speed and 16-speed V-belt horizontal motor drives offer more spindle speeds—an advantage when surface speeds are critical. These lathes are identical in all other respects to those described on the preceding page.

Price includes 1 ph., 60 cy., 115 v., A.C. motor, drum control, and regular lathe equipment such as belt, centers, small fac plate, tool post, etc. Chucks, collets, tools, and bench are extra.

TIME PAYMENT TERMS

25 per cent down
12 months to pay balance
Moderate finance charges

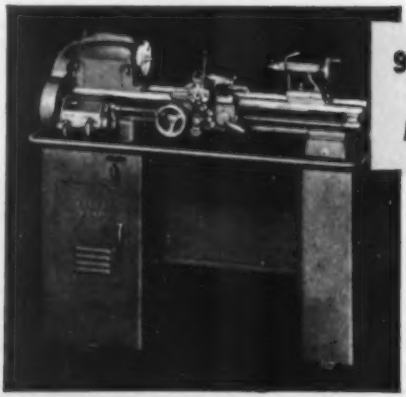
SPECIFICATIONS

Swing over saddle wings.....9¼"
Swing over chip guard.....5½"
Hole thru spindle.....¾"
Collet capacity.....½"
Spindle speeds
8 speed drive....46 to 609 r.p.m.
16 speed drive....48 to 1176 r.p.m.
Thread cutting range:
Model A.....48 pitches R.H. or L.H. 4 to 224 per inch.
Models B & C.45 pitches R.H. or L.H. 4 to 160 per inch.

Power longitudinal feeds
Model A.....48—.0015" to .0853"
Model B.....26—.0021" to .0155"
Model C.....14—.0021" to .0156"
Power cross-feeds
Model A.....48—.0004" to .0252"
Model B.....23—.001" to .0046"
Spindle centers.....No. 2 Morse Taper
Size motors
8 speed drive.....¼ h.p.
16 speed drive.....½ h.p.

9-Inch Bench Lathes with V-Belt Horizontal Motor Drive

Length Bed Feet	Between Centers Inches	Ship. Wt. Crated Pounds	MODEL A				MODEL B				MODEL C			
			8-speed drive		16-speed drive		8-speed drive		16-speed drive		8-speed drive		16-speed drive	
			Cat. No.	Price	Cat. No.	Price	Cat. No.	Price	Cat. No.	Price	Cat. No.	Price	Cat. No.	Price
3	16	355	544-Y	$294.20	744-Y	$339.70	577-Y	$239.20	777-Y	$284.70	515-YC	$189.20	715-YC	$234.70
3½	22	380	544-Z	309.20	744-Z	354.70	577-Z	254.20	777-Z	299.70	515-ZC	204.20	715-ZC	249.70
4	28	405	544-A	324.20	744-A	369.70	577-A	269.20	777-A	314.70	515-AC	219.20	715-AC	264.70
4½	34	430	544-R	346.20	744-R	391.70	577-R	291.20	777-R	336.70	515-RC	241.20	715-RC	286.70



9" SOUTH BEND
Underneath Motor Driven Lathe

Capable of machining work to the most exacting tolerances, this lathe is recommended for precision work in the toolroom, laboratory, or machine shop. Fully enclosed motor drive unit provides twelve spindle speeds, 41 to 1270 r.p.m. See above for other specifications. Price includes 1 ph., 60 cy., 115 v., A.C. motor, drum control, and regular lathe equipment. Chucks, collets, and tools are extra.

9" Underneath Motor Driven Lathes

Catalog Number	Model	Length of Bed Feet	Between Centers Inches	Weight Crated Pounds	Price f.o.b. Factory
344-ZN	A	3½	22	570	$486.70
377-ZN	B	3½	22	560	431.70
B344-ZN	Toolroom	3½	22	630	655.70

SOUTH BEND LATHE WORKS, 524 E. Madison Street, South Bend 22, Indiana, U.S.A.

SPECIFICATIONS	SERIES 900	SERIES 1000	SERIES 2-H
Collet capacity	½"	1"	1"
Hole thru spindle	¾"	1⅜"	1⅜"
Swing over bed and saddle wings	9¼"	10⅛"	16¼"
Swing over double tool-slide	3-9/16"	3-9/16"	6⅞"
Swing over compound slide	5½"	5⅞"	
Turret tool feed	4"	4"	6⅛"
Turret face to spindle distance, max	20⅝"	19⅝"	6' bed—28¼"
Double tool slide cross travel	3⅝"	3⅝"	9⅝"
Thread cutting range, 48	4—224 per in.	4—224 per in.	4—224 per in.
Spindle speeds, 12	41-1270 r.p.m.	50—1357 r.p.m.	16-880 r.p.m.
Carriage power feeds:			
Longitudinal, 48	.0015"—.0853"	.0015"—.0836"	.0015"—.0841"
Transverse, 48	.0004"—.0252"	.0006"—.0309"	.0006"—.0312"
Carriage longitudinal travel	18"	16"	6' bed—22½"
Turret power feeds	.....	.....	.0001"—.0148"
Turret indexing tolerance at 4" from turret face	.0005"	.0005"	.0005"
Size motor	½ h.p.	¾ h.p.	1½ h.p.

SOUTH BEND

Precision Turret Lathes

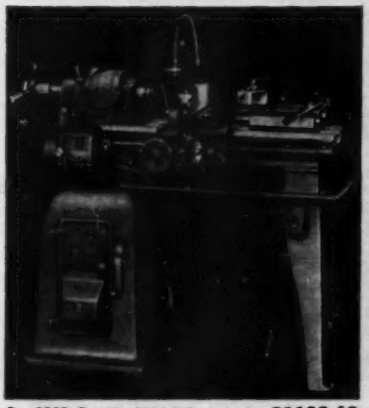
Series 900. This turret lathe is specifically designed for second operations on small, precision parts. Its accuracy, and speed of handling and machining produce appreciable economies in manufacturing that are not possible with heavy turret lathes. Price includes 1 ph., 60 cy., 115 v., A.C. motor, drum control, power feed universal carriage, handlever bed turret, handlever cross slide, compound rest cross slide, coolant return assembly, and metal column base with built-in oil pan.

Series 1000. Designed for the same types of applications as the Series 900, these turret lathes with their larger capacities are ideal for machining a wide variety of precision parts. Numerous choices of spindle speeds, power longitudinal and transverse carriage feeds, and thread cutting feeds keep production efficient. Price includes 3 ph., 60 cy., 220 v., A.C. motor, drum control, power feed universal carriage, handlever bed turret, handlever cross slide, compound rest cross slide, oil pan, and coolant return assembly.

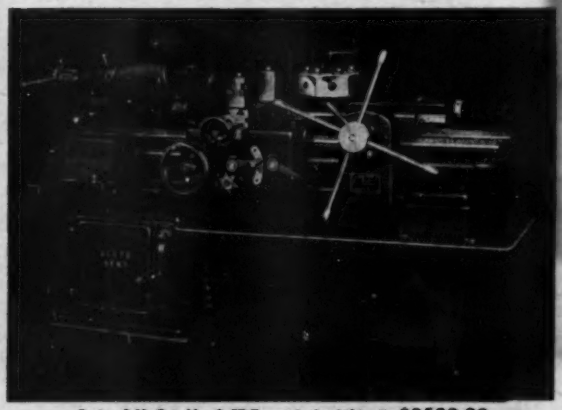
Series 2-H. The production of precision duplicate parts in both machine shops and toolrooms is simplified with 2-H Turret Lathes. They are especially suited for exacting second operations on large work because of their accuracy and ease of operation. Price includes 3 ph., 60 cy., 220 v., A.C. motor, drum control, power feed universal carriage with screw feed double tool slide having front and rear tool blocks, power feed ram-type turret, and oil pan.

Prices of turret lathes do not include coolant pump or collet equipment.

Ser. 900, Cat. No. 930-Z Turret Lathe **$763.70**



Ser. 1000, Cat. No. 1006-Z Turret Lathe **$1199.60**



Series 2-H, Cat. No. 2-CT Turret Lathe (6' bed) **$2500.00**

SOUTH BEND LATHE WORKS, 524 E. Madison Street, South Bend 22, Indiana, U.S.A.

HANDLEVER COLLET ATTACHMENT

The Handlever Collet Attachment is an aid to rapid production work. Stock can be released and fed through the collet without stopping the lathe.

Handwheel Draw-in Collet Attachment

Prices start at **$25**

Collet Attachment

HANDWHEEL TYPE

The Handwheel Collet Attachment is a very accurate type of chuck. It is used for precision toolroom work and for the manufacture of small parts, or wherever extremely close tolerances are required. Bar and tube stock can be fed through the hollow draw-bar that operates the collet. Equipment includes draw-bar, spindle nose cap, spanner wrench, and closing sleeve. Collets are not included.

DRAW-IN COLLET ATTACHMENTS

Size of Lathe	Collet Required	Max. Collet Cap.	Handwheel Type		Handlever Type	
			Catalog Number	Price	Catalog Number	Price
9" and Series 900	No. 3	½"	4306-W	$25	5206-W	$ 85
10"—11/16" Collet	No. 2	11/16"	4310	40	5210	120
10"—1" Col. & Series 1000	No. 5	1"	4312	50	5219	150
13"	No. 2	11/16"	4313	40	5213	120
14½"	No. 4	¾"	4314	45	5214	140
16", 16/24", & No. 2-H	No. 5	1"	4316	50	5216	150

Collet Rack and Collet Chest

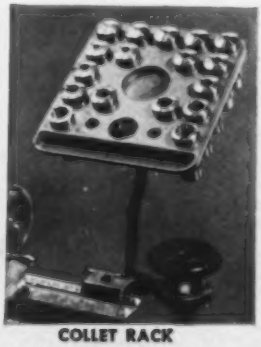
Collet Rack No. 1770-W holds 19 collets, all others hold 17 collets. Collets are not included.

COLLET RACKS

Catalog Number	Size of Lathe	Price
1770-W	9" and 900	$12
1752	10"—11/16" Col.	15
1753	10"—1" Col.	17
1783	Ser. 1000	17
1772	13"	15
1791	14½"	17
1774	16" & 16/24"	17

No. 2225—Collet Chest only, for holding handwheel collet attachment and collets for 9" lathe. Collet attachment and collets not included. Price: $7.50

No. 2220—Collet Chest, 9" handwheel collet attachment and 29 steel collets for round work, 1/16" to ½" by 64ths. Complete: $122.00



COLLET RACK

Holds collets, centers, spindle sleeve, draw-bar, spindle nose cap, wrench, etc.

TIME PAYMENT TERMS

When order includes lathe
25 per cent down
12 months to pay balance
moderate finance charges

COLLET CHEST

Holds handwheel collet attachment and 29 collets. Well constructed of wood.

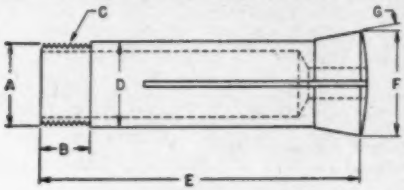
SOUTH BEND LATHE WORKS, 524 E. Madison Street, South Bend 22, Indiana, U.S.A.

Collets and Collet Sets

South Bend Collets, manufactured with the same exacting care as South Bend Lathes, deliver long, dependable service on precision work. Each collet is carefully inspected and tested, and packed in substantial plastic box with transparent lid through which the size can be read for easy selection.

Steel Collets are carefully heat-treated for maximum service and are precision ground to exceedingly close tolerances.

Brass Collets, a South Bend innovation, have many practical applications. Their low cost makes them desirable for odd sizes that are used only occasionally. They can be readily machined on the job for holding tapered or irregular shapes. When worn, they can be rebored to larger diameters.



Specifications of Steel and Brass Collets

Collet Number	* For South Bend Lathes	A Thread Diameter Inches	B Thread Length Inches	C Threads Per Inch	D Body Diameter Inches	E Collet Length Inches	F Head Diameter Inches	G Angle Length Degrees
3	9" and Series 900	.650	3/4	26	.6495	2-11/16	.852	12
2	10"—11/16" Col. and 13"	.855	13/16	20	.8595	3-5/16	1.095	15
5	10"—1" Collet, 1000, 2-H, 16", and 16/24"	1.250	3/4	20	1.2495	3-9/32	1.452	10
4	14½"	.950	13/16	20	.9495	3	1.150	10

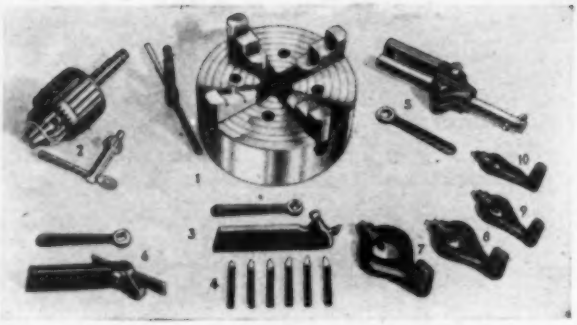
*Collets can also be used on any other lathe or machine which they will fit.

South Bend Collets and Collet Sets

Collet	Description	Steel Collets Cat. No.	Steel Collets Price	Brass Collets Cat. No.	Brass Collets Price
No. 3	1 Collet, any standard size 1/16" to 1/2" in 64ths	609-W	$ 3.75	1696	$ 2.00
	Set of 8 Collets in 16ths, 1/16" to 1/2"	2047	27.00	2235	15.00
	Set of 7 Collets in odd 32nds, 3/32" to 15/32"	2476	24.00	2534	13.00
	Set of 14 Collets in odd 64ths, 5/64" to 31/64"	2477	46.00	2535	24.00
	Decimal Collets (.0625" to .500") each	769-W	4.00	1856	2.15
	Metric Collets (1.5 mm to 12.5 mm) each	773-W	4.00	1702	2.15
No. 2	1 Collet, any standard size 1/16" to 11/16" in 64ths	1721	4.00	1697	2.25
	Set of 11 Collets in 16ths, 1/16" to 11/16"	2432	39.00	2238	23.00
	Set of 10 Collets in odd 32nds, 3/32" to 21/32"	2478	36.00	2536	21.00
	Set of 20 Collets in odd 64ths, 5/64" to 43/64"	2479	71.00	2537	40.00
	Decimal Collets (.0625" to .6875") each	769-N	4.25	1857	2.40
	Metric Collets (1.5 mm to 17.0 mm) each	773-N	4.25	1703	2.40
No. 5	1 Collet, any standard size 1/16" to 1" in 64ths	1722	4.75	1698	2.50
	Set of 16 Collets in 16ths, 1/16" to 1"	2435	68.00	2241	37.00
	Set of 15 Collets in odd 32nds, 3/32" to 31/32"	2482	64.00	2540	35.00
	Set of 30 Collets in odd 64ths, 5/64" to 63/64"	2483	127.00	2541	65.00
	Decimal Collets (.0625" to 1.000") each	769-R	5.00	1858	2.65
	Metric Collets (1.5 mm to 25.0 mm) each	773-R	5.00	1704	2.65
No. 4	1 Collet, any standard size 1/16" to 3/4" in 64ths	1713	4.25	1699	2.35
	Set of 12 Collets in 16ths, 1/16" to 3/4"	2438	46.00	2244	26.00
	Set of 11 Collets in odd 32nds, 3/32" to 23/32"	2480	42.00	2538	24.00
	Set of 22 Collets in odd 64ths, 5/64" to 47/64"	2481	81.00	2539	45.00
	Decimal Collets (.0625 to .7500") each	769-K	4.50	1859	2.50
	Metric Collets (1.5 mm to 19.0 mm) each	773-K	4.50	1705	2.50

Chuck and Tool Assortments

The chucks and tools in the assortments shown are recommended for use with the various South Bend Lathes. This is the basic equipment required for the average shop for general machine work, such as turning, boring, drilling, cutting-off, chucking, etc. A 3-jaw Universal chuck can be substituted for the 4-jaw Independent at additional cost.



Contents of Assortment

4-Jaw Independent Lathe Chuck fitted to lathe. Sizes: 6 in. on 9" and 10" Lathes; 7½ in. on 13" Lathe; 9 in. on 14½" Lathe; 10 in. on 16" and 16/24" Lathes.
Jacobs 3-Jaw Drill Chuck. Sizes: ½ in. on 9" and 10" Lathes; ¾ in. on 13" and 14½" Lathes; 1 in. on 16" and 16/24" Lathes.
Arbor Fitted to Above Drill Chuck.
Straight Shank Tool Holder.
6 Ground Cutter Bits for Tool Holder.
Boring Tool Holder, Style "B." 9" Lathes take Style "D."
Cutting-Off Tool Holder, Right-Hand.
4 Malleable Lathe Dogs. Sizes: ½", ¾", 1", and 1¼" on 9" and 10" Lathes; ½", ¾", 1", and 1½" on all others.

Prices of Complete Assortments

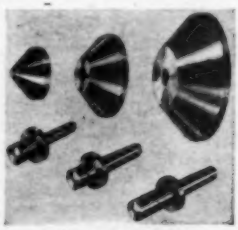
Size of Lathe	Catalog No.	Price
9" & 900	105-WT	$53.44
10"—11/16" Collet	110-T	92.27
10"—1" Collet & 1000	110-L	93.27
13"	113-T	107.81
14½"	114-T	121.58
16" & 16/24"	116-T	141.88

Wood Turning Rest

Mounts on compound rest base to convert lathe for wood turning. See following pages for centers for wood turning.

Prices Start At $9

Size of Lathe	Catalog No.	Price
9"	896-W	$ 9
10"	1069	12
13"	1073	14
14½"	1165	18
16" and 16/24"	1075	18

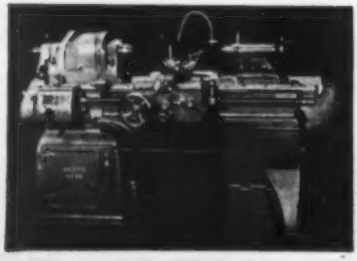


Pipe Centers

Cat. No.	Takes Pipe	Requires Shank	Price
2160	½" to 3"	2172-NR	$4.50
		or	
2161	3" to 5"	2172-TH	6.00
2162	5" to 8"	2173-TH	9.00

Pipe Center Shanks

Cat. No.	Taper	Price
2172-NR	No. 2	$4.50
2172-TH	No. 3	4.50
2173-TH	No. 3	7.50



Chip Pans and Oil Pans

Oil Pans, Splash Pans, and Chip Pans can be supplied for all South Bend Lathes. Oil Pans should be factory-installed for proper fit. Complete information and prices will be supplied on request.

TIME PAYMENT TERMS

When order includes lathe 25 per cent down 12 months to pay balance Moderate finance charges

Milling and Keyway Cutting Attachment

Milling and Keyway Cutting Attachment

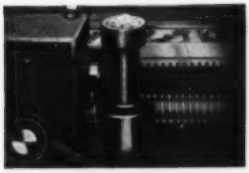
This useful attachment is ideal for shops not having enough of this work to justify a milling machine. Mounts on compound rest base of lathe, permitting the power cross and longitudinal feeds to be used for milling, boring and keyway cutting operations on work held in the milling attachment vise. Vise swivels in any direction, 180° horizontal and vertical graduations. Vertical slide adjusting screw equipped with micrometer graduated collar.

Size Lathe	Cat. No.	Vise Cap.	Price
9" & 900	9-W	1½"	$35
10" & 1000	1-N	1¾"	45
13"	3	2⅞"	55
14½"	4-K	4"	65
16", 16/24"	5	4"	75

Arbors for Milling Cutters

Holds cutters with 1" holes. Capacity between nut and shoulder, 1½". 3 spacing collars furnished. All shanks No. 3 Morse Taper.

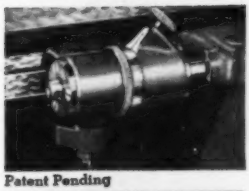
Lathe Size	Catalog No.	Price
9" & 900	109-NH	$7
10" & 1000	109-NH	7
13"	109-NH	7
14½"	109-NH	7
16", 16/24",	109-NH	7



Thread Dial Indicator

Eliminates reversing of lathe spindle when cutting threads. Dial is numbered and graduated to show when to close half-nuts on lead screw to catch the thread on the next successive cut, after returning carriage to starting point.

Lathe Size	Catalog No.	Price
9" & 900	810-W	$ 8
10" & 1000	1588	13
13"	813	15
14½"	813	15
16", 16/24", 2-H	813	15

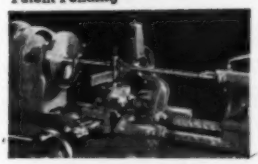


Patent Pending

Micrometer Carriage Stop

Locates the carriage at any point along the bed for accurate facing, turning, boring, etc. Has accurately graduated micrometer collar. Stop is hardened on both ends for use on either side of carriage. Can be locked for duplicate work.

Size of Lathe	Catalog No.	Price
9" & 900	968-W	$15
10" & 1000	1518	16
13"	973	18
14½"	1502	19
16", 16/24", 2-H	975	19



Follower Rest

Supports long, slender shafts being machined between centers. Attaches to, and travels with, the carriage. Adjusting screws and lock screws are provided for setting the jaws in position. Slots in bottom of follower rest permit quick attachment or removal.

Size of Lathe	Catalog No.	Capacity Max.	Capacity Min.	Price
9" & 900	34-W	2"	3/16"	$4.75
10" & 1000	1353	2½"	3/16"	7.00
13"	376	3½"	3/16"	8.00
14½"	1351	4¼"	3/16"	9.00
16"	730	4¼"	3/16"	10.00
16/24"	1352	4¼"	3/16"	15.00

Center Rest

Clamps on inside ways of lathe bed and is used for supporting long shafts, boring spindles, etc. The 3 jaws are adjustable, and are made of cast iron. Top of center rest is hinged to facilitate inserting and removing shafts.

Size of Lathe	Catalog No.	Capacity Max.	Capacity Min.	Price
9" & 900	125-W	3"	¼"	$ 7
10" & 1000	1177	3"	¼"	10
13"	341	3¾"	⅜"	13
14½"	1174	4¾"	⅜"	16
16"	720	4¾"	⅜"	18
16/24"	1175	4¾"	⅜"	24

Taper Attachments

Telescopic and Plain

Taper turning and boring are as easily accomplished as straight turning on lathes equipped with South Bend Taper Attachments. The Taper Attachments are permanently mounted on the lathe carriages, and must be fitted at the factory. Accuracy and smooth operation are assured by their practical design and rugged construction. The swivel bar is graduated in both degrees and taper per foot.

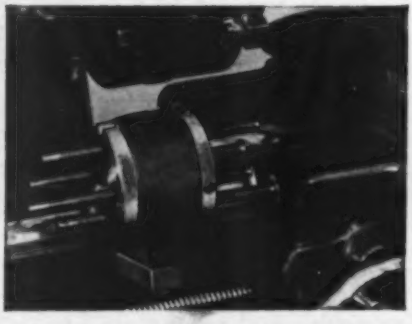
Telescopic Taper Attachments are used only on 10" and larger lathes. A telescopic cross-feed screw eliminates the necessity of disconnecting the cross-feed nut when tapers are machined. The Plain Taper Attachment used on 9" Lathes requires the disconnecting of the cross-feed screw and nut.

Telescopic Taper Attachment

Size of Lathe	Catalog Number	Max. Length at One Setting	Max. Taper per Foot	Max. Taper in Degrees	Price
9" and 900....	428-W	7"	3½"	16½"	$ 73
10" & 1000....	1545	8½"	3½"	16½"	137
13".....	379	9¼"	3½"	16½"	154
14½".....	399	9¼"	3½"	16½"	165
16" & 16/24"..	381	11½"	3½"	16½"	185

TIME PAYMENT TERMS

When order includes lathe
25 per cent down
12 months to pay balance
Moderate finance charges



Four Position Carriage Stop

Much time can be saved in positioning the cutting tool for repetative operations, by using this four position carriage stop. Each of the four adjustable stops may be set for a different tool position, and may be revolved to locate the carriage for each of four successive cuts. This attachment is especially desirable when a square turret tool block carrying up to four cutting tools is used. It may be clamped on either side of the carriage to position the tool either from left to right, or from right to left.

Cat. No.	Size Lathe	Price
2185-N	9".....	
2185-R	10".....	Price
2185-T	13".....	on
2185-F	14½".....	Request
2185-H	16", 16/24", 2-H	

Metric Transposing Gears

Metric screw threads from 6 mm to 0.20 mm pitch (L.H. & R.H.) can be cut when Metric Transposing Gears are used. Prices when ordered with lathe.

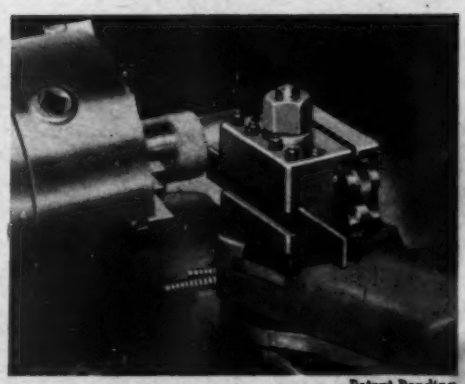
Size of Lathe	Catalog No.	Price
Mdl. A 9" & 900...	1955-W	$10
Mdl. B or C 9" & 900.	1759-W	12
10" & 1000.....	1963	40
13".....	1957	45
14½".....	1961	50
16".....	1959	55
16/24".....	1960	50

SOUTH BEND LATHE WORKS, 524 E. Madison Street, South Bend 22, Indiana, U.S.A.

Universal Tool Block

The new Universal Tool Block replaces the conventional tool post and various tool holders ordinarily used for general lathe work. It provides rigid support for turning, boring, threading, and cut-off tool bits. In addition, it is equipped with a self-aligning knurling head. Screw adjustments for tool height are easily made, and they stay put. No readjustment is required when replacing tools. This tool block can be adapted to fit other makes of lathes.

Size of Lathe	Cat. No.	Price
9".....	1413-N	$11.25
10".....	1413-R	11.75
13".....	1413-T	13.75
14½".....	1413-F	15.75
16" & 16/24"	1413-H	16.25



Patent Pending

Universal Tool Block

Patent Pending

Square Turret Tool Block

for Double Tool Cross Slide

The turret indexes within .0005", permitting each of four tools to be used in sequence for rough turning, finish turning, facing, boring, cutting-off, or other operations as required. A quick-acting lever locks the turret securely in each of the four positions. Rocker adjustment is provided for adjusting height of each tool. For use on the double tool cross slides of South Bend Lathes, but can be adapted for use on other makes.

Tool Blocks for Double Tool Cross Slides

Size of Lathe	Catalog Number	Size Square	Takes Tools	Price
9" & 900.....	41-ND	3"	⅜" x ⅜"	$40
10" & 1000.....	41-ND	3"	⅜" x ⅜"	40
16".....	42-ND	4"	⅝" x ⅝"	70

Patent Pending

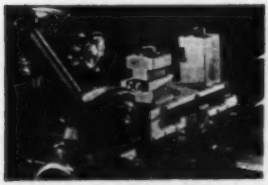
Square Turret Tool Block

for Compound Cross Slide

Used on compound cross slides for same purpose as tool block described at left. Turret indexes within .0005" to each of four positions and locks by means of lever. Rocker adjustments provided for tools. Ruggedly constructed. This tool block is for use on compound rest cross slides of South Bend Lathes but can be adapted for use on other makes.

Tool Blocks for Compound Cross Slides

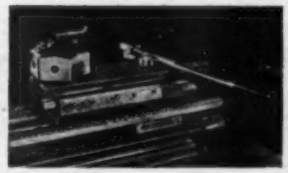
Size of Lathe	Catalog Number	Size Square	Takes Tools	Price
9" & 900.....	40-NC	3"	⅜" x ⅜"	$45
10" & 1000.....	41-NC	3"	⅜" x ⅜"	45
13".....	43-NC	3"	⅜" x ⅜"	50
14½".....	44-NC	4"	⅝" x ⅝"	70
16" & 16/24".....	42-NC	4"	⅝" x ⅝"	75



Handlever Double Tool Cross Slide

Ideal for increasing production on repetitive operations. Three 7/16" square cutter bits can be used—two in front tool block, one in rear tool block. Mounts on saddle cross slide in place of compound rest. Can be operated by handlever or power cross-feed.

Size of Lathe	Catalog Number	Swing over Slide	Price
9" & 900...	2030-W	3-9/16"	$75
10" & 1000.	2031	3-9/16"	90



Handlever Bed Turret

Turret head indexes automatically when lever is moved to extreme right. Each turret face has independently adjustable feed stop screw which accurately regulates length of cut. Effective feed of turret slide 4". Turret indexes within .0005" four inches from turret face.

Size of Lathe	Cat. No.	Price
9" & 900.....	1611-W	$200
10" & 1000....	1612	210
13".....	1613	225

Standard and Safety Lathe Dogs

Lathe dogs should correspond in capacity to the diameter of the work if the work is to be held securely. These lathe dogs are made of heavy malleable iron and are properly designed for maximum strength and long service. The Standard Lathe Dog has square head alloy steel set screw. The Safety Lathe Dog has a headless alloy steel set screw.

Lathe Dogs for 13" and Larger Lathes

Cap. In.	STANDARD Cat. No.	STANDARD Price	SAFETY Cat. No.	SAFETY Wrench Required	SAFETY Price
½	3843	$0.80	3826	2385	$0.80
¾	3844	.95	3827	2386	.95
1	3845	1.05	3828	2387	1.05
1¼	3846	1.20	3829	2388	1.20
1½	3847	1.40	3830	2389	1.40
1¾	3848	1.55	3831	2389	1.55
2	3849	1.70	3832	2389	1.70
2½	3850	1.95	3833	2390	1.95
3	3851	2.20	3834	2390	2.20
3½	3852	3.00	3835	2390	3.00
4	3853	4.00	3836	2390	4.00

Lathe Dogs for 9" and 10" Lathes

Cap. In.	STANDARD Cat. No.	STANDARD Price	SAFETY Cat. No.	SAFETY Wrench Required	SAFETY Price
⅝	3837	$0.70	3820	2385	$0.70
½	3838	.75	3821	2385	.75
¾	3839	.90	3822	2386	.90
1	3840	1.00	3823	2387	1.00
1¼	3841	1.10	3824	2388	1.10
1½	3842	1.35	3825	2388	1.35

A complete set of lathe dogs is a must in any shop.

Lathe Centers and Drill Pads

Patent Pending

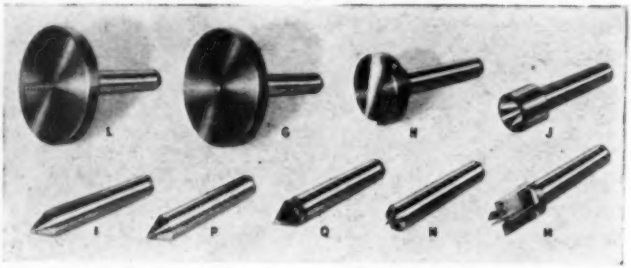
Ball Bearing Live Center

Designed for maximum strength and rigidity, the Ball Bearing Live Center is recommended for high speeds, heavy roughing cuts, etc. 60° point runs in substantial precision ball bearing which is easily replaceable.

Catalog No.	Shank Taper	Price
3900	No. 2	$11.50
3901	No. 3	13.50

TIME PAYMENT TERMS

When order includes lathe
25 per cent down
12 months to pay balance
Moderate finance charges



L—Screw Center for wood turning. G—Drill Pad to support flat work for drilling. H—Crotch Center supports round work for cross drilling. J—Hollow Center for supporting centerless shafts up to ⅞" dia. I—60° Center for headstock or tailstock spindles P—Carbide Center. Q—Half Center. N—Cup Center. M—Spur Center, for all wood turning operations.

Description	No. 2 Taper for 9" and 10" Lathes Cat. No.	No. 2 Taper Price	No. 3 Taper for 13", 14½", & 16" Cat. No.	No. 3 Taper Price
L—Screw Center	731-NR	$3.00	731-TH	$3.25
G—Drill Pad	727-NR	2.50	727-TH	2.75
H—Crotch Center	728-NR	2.50	728-TH	3.25
J—Hollow Center	1896-NR	2.00	1896-TH	2.75
I—60° Center	726-NR	2.25	726-TH	3.00
P—Carbide Center	1889	4.50	1890	8.00
Q—Half Center	926-NR	2.25	926-TH	3.00
N—Cup Center	733-NR	2.00	733-TH	2.75
M—Spur Center	732-NR	3.00	732-TH	3.25

SOUTH BEND LATHE WORKS, 524 E. Madison Street, South Bend 22, Indiana, U.S.A.

Coolant Pump and Reservoir

(Not Fitted to Lathe at Factory)

The coolant equipment listed below includes motor driven coolant pump, tubing, reservoir and tray, ¼ h.p. motor (see table below), switch, and wiring for connecting switch to motor. Pump is self-priming as it is below the oil level. Reservoir intake is fitted with large filter screen. This coolant equipment can be used with lathes and other machine tools. When ordering, specify voltage, phase, and cycle of motor wanted.

Cat. No.	Motor Specifications				Price
	Current	Phase	Cycle	Voltage	
2003-C	A.C.	3	50	220	$117.00
2003-D	A.C.	3	60	220	117.00
2003-E	A.C.	3	50	440	117.00
2003 F	A.C.	3	60	440	117.00
2001-A	A.C.	1	50	115	105.00
2001-B	A.C.	1	60	115	103.00
2001-C	A.C.	1	50	230	106.00
2001-D	A.C.	1	60	230	105.00
2000-K	D.C.	...	...	115	128.00
2000-L	D.C.	...	...	230	128.00

Patented

Mica Undercutting Attachment

Any shop that repairs armatures for motors, generators or starters will have a lot of use for this practical attachment. It attaches to the saddle of the lathe which insures rigidity and alignment. The blade travels parallel to the commutator bars which insures clean, straight cutting. Upper portion is hinged so the blade holder can be swung back so it does not interfere with turning the commutator.

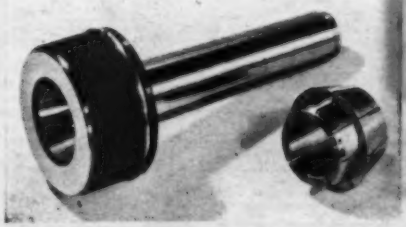
Price includes one blade .020" thick. Extra cutter blades .020" and .015" thick are available as listed below.

Size of Lathe	9"		10"		13"		14½"		16"	
Description	Cat. No.	Price	Cat. No.	Price	Cat. No.	Price	Cat. No.	Price	Cat. No.	Price
Mica Undercutting Attachment	675-N	$18.00	675-R	$18.00	675-T	$19.00	675-F	$20.00	675-H	$21.00
Extra Blade, .015"	2028	.15	2028	.15	2028	.15	2028	.15	2028	.15
Extra Blade, .020"	2029	.25	2029	.25	2029	.25	2029	.25	2029	.25

Adjustable Collet Bushing Chuck

The adjustable collet bushing chuck provides an extremely accurate, but inexpensive equipment for mounting centerless armature shafts, and similar parts, in the lathe. Can be used in either head or tail spindle of lathe. Collets are made of brass, and may be adjusted for either running fit or driving fit on shaft.

Description	Cat. No.	Shank	Price
Adjustable Collet Bushing Chuck Only	1615-NR	No. 2	$6.25
	1615-TH	No. 3	6.75
Adjustable Collet Bushing Chuck with set of 3 collets, 9/16", 5/8" and .637" capacity for popular armatures	1608-NR	No. 2	8.95
	1608-TH	No. 3	9.45



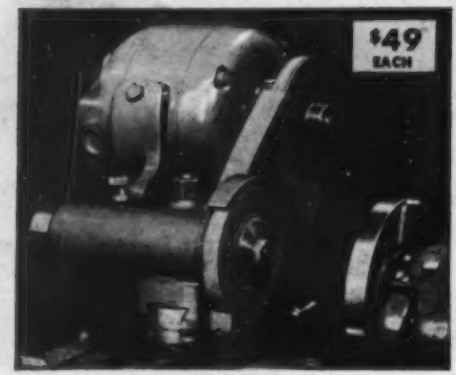
Cat. No. 1659, Extra Collets for round work, any capacity ¼" to 1" round by 16ths, price each $1.00.

Two Superb Grinding Attachments

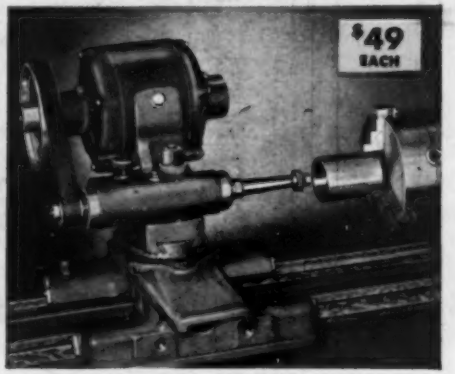
South Bend Design and Manufacture

External—This powerful and efficient grinding attachment is recommended for external grinding. Designed to fit the various sizes of South Bend Lathes, it is easily adaptable for use on milling machines, shapers, planers, or other makes of lathes. The spindle revolves on prelubricated, precision ball bearings which are sealed to protect them from damage by dust, grit and metal particles produced when grinding. Supplied with ¼ h.p., 1725 r.p.m. constant speed continuous duty motor, 4" x ½" grinding wheel.

Internal—Designed as a companion to the External Grinding Attachment, this grinder is intended for all types of internal grinding. It is equipped with a ⅛ h.p. constant speed continuous duty motor. Spindle runs in precision ball bearings. Changeable pulleys provide 3 spindle speeds of approximately 13,000, 15,000, and 18,000 r.p.m. Uses standard Norton and Carborundum grinding wheels. Extension quill permits grinding holes up to 2¼" deep. Price includes belt and three assorted grinding wheels.



External Grinding Attachment



Internal Grinding Attachment

Prices include motor for 115 v., 60 cy., 1 ph., A.C. current.
Prices with other motors quoted on request.

TIME PAYMENT TERMS

When order includes lathe 25 per cent down 12 months to pay balance moderate finance charges

Size of Lathe	EXTERNAL GRINDER		INTERNAL GRINDER	
	Catalog No.	Price	Catalog No.	Price
9" & Series 900	301-BN	$49	201-BN	$49
10"—11/16" Col.	301-BR	49	201-BR	49
10"—1" Col. & 1000	301-BR	49	201-BR	49
13"	301-BT	49	201-BT	49
14½"	301-BF	49	201-BF	49
16" & 16/24"	301-BH	49	201-BH	49

Above: Grinding a cutter with spring stop in holding fixture. Right: Grinding spiral reamer.

Reamer and Cutter Grinding Stops

Consists of adjustable holding fixture which clamps on lathe bed for holding adjustable grinding stops and diamond dresser for grinding wheels. Also a grinding stop which attaches to grinding wheel guard and travels with grinder for grinding spiral reamers and cutters.

Size of Lathe	9" Ser. 900	10" Ser. 1000	13"	14½"	16"	16/24"
Catalog No.	1512-N	1512-R	1512-T	1512-F	1512-H	1512-V
Price	$15	$16	$18	$20	$20	$29

SOUTH BEND LATHE WORKS, 524 E. Madison Street, South Bend 22, Indiana, U.S.A.

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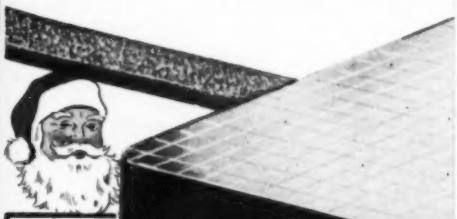
SYNCRO

DELUXE JIG SAW

For Hobbyists, Craftsmen, Light Production

GREATEST CLEARANCE, LARGEST TABLE TOP, MO

POWERFUL—OF ANY MAGNETIC SAW MADE!

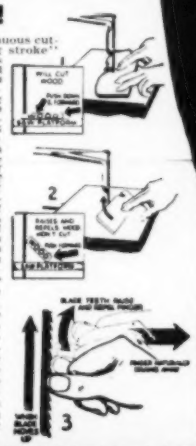


FAMILY SAW

"The SYNCRO POWER SAW ordered from you in 1940 is still sawing merrily away. My son (then 8) has used it in the attic, kitchen, his room, and basement shop. I use it too. We never worry about accidents due to its MAGNETIC SAFETY STROKE feature. It's truly a family saw." Mr. B. H. Smith, "exburg, Idaho.

SAFE!

SYNCRO has No continuous cutting blade nor "Long stroke" blade to pull fingers into teeth — instead there are 14,400 strokes per minute — 7,200 short cutting strokes plus 7,200 upward NON-CUTTING, REPELLING strokes. (Fig. 1) SYNCRO will not even CUT wood unless piece is pushed FIRMLY DOWNWARD AGAINST blade and FIRMLY FORWARD — both actions at SAME time! SYNCRO blade teeth cut ONLY on DOWN stroke. (Fig. 2) Teeth raise, repel, push away any object on UP stroke. (Fig. 3) When blade moves UP it KICKS finger away free. On down stroke blade does not move far enough to accidentally cut finger unless finger is intentionally, deliberately fed into blade like wood is fed in Figure 1. No wonder SYNCRO is the world's SAFEST saw . . . a feature old and young users acclaim!



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WORLD'S SAFEST SAW

SAW CORP
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WORLD'S LARGEST MAK

An Unsolicited Testimonial

S. CLAUS WORKSHOP
North Pole, Arctic

SYNCRO SAW CORPORATION
ROCHESTER—MICHIGAN
Gentlemen:

The heart of every Dad and Lad beats a little bit faster at Christmas Time—and your safe, magnetic jig saws will be partly responsible. I have used your SYNCRO SAW in my own workshop for many years to help make the beautiful gifts I deliver around the world every Christmas Eve.

I have found SYNCRO to be the handiest tool in my workshop and heartily recommend them as Christmas and year around gifts to men, boys and girls. They are safe, practical and symbolical of the Christmas Spirit in their rich, red appearance.

Tell your customers that I'll promise to personally deliver every SYNCRO they order!

Faithfully yours,
S. Claus

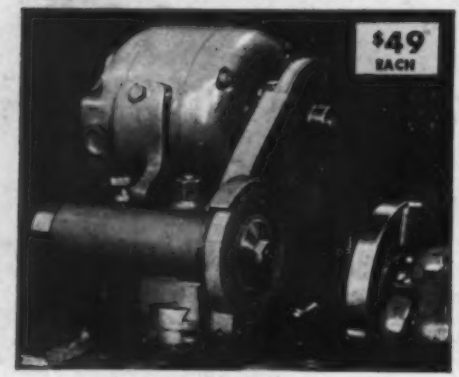
SOUTH BEND LATHE A

Two Superb Grinding Atta

South Bend Design and Manufa

External—This powerful and efficient grinding attachment is recommended for external grinding. Designed to fit the various sizes of South Bend Lathes, it is easily adaptable for use on milling machines, shapers, planers, or other makes of lathes. The spindle revolves on prelubricated, precision ball bearings which are sealed to protect them from damage by dust, grit and metal particles produced when grinding. Supplied with ¼ h.p., 1725 r.p.m. constant speed continuous duty motor, 4" x ½" grinding wheel.

Internal— External Grin tended for al equipped with duty motor. S ings. Change speeds of ap 18,000 r.p.m. rundum grind grinding hole belt and thre



External Grinding Attachment

Prices include motor for 115 v., 6
Prices with other motors

TIME PAYMENT TERMS

When order includes lathe 25 per cent down 12 months to pay balance moderate finance charges

Size of Lathe	EXTERNAL GR Catalog No.
9" & Series 900	301-EN
10"—11/16" Col.	301-BR
10"—1" Col. & 1000	301-BR
13"	301-BT
14½"	301-BF
16" & 16/24"	301-BH

Above: Grinding a cutter with spring stop in holding fixture. Right: Grinding spiral reamer.

Reamer and C

Consists of adjustable holdin holding adjustable grinding st wheels. Also a grinding stop w and travels with grinder for gri

Size of Lathe	9" Ser. 90
Catalog No.	1512-
Price	$15

SOUTH BEND LATHE WORKS, 524 E. Madison Street,

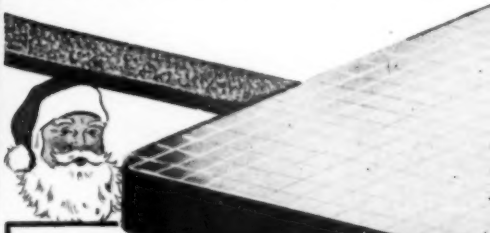
No. 2000

SYNCRO

DELUXE JIG SAW

For Hobbyists, Craftsmen, Light Production

GREATEST CLEARANCE, LARGEST TABLE TOP, MOST POWERFUL—OF ANY MAGNETIC SAW MADE!

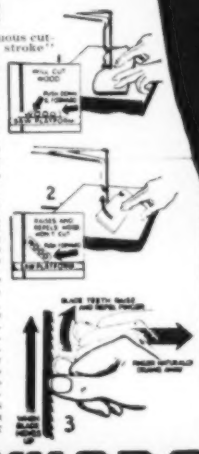


FAMILY SAW

"The SYNCRO POWER SAW ordered from you in 1940 is still sawing merrily away. My son (then 8) has used it in the attic, kitchen, his room, and basement shop. I use it too. We never worry about accidents due to its MAGNETIC SAFETY STROKE feature. It's truly a family saw." Mr. B. H. Smith, Pexburg, Idaho.

SAFE!

SYNCRO has No continuous cutting blade nor "Long stroke" blade to pull fingers into teeth — instead there are 14,400 strokes per minute—7,200 short cutting strokes plus 7,200 upward NON-CUTTING, REPELLING strokes. (Fig. 1) SYNCRO will not even CUT wood unless piece is pushed FIRMLY DOWNWARD AGAINST blade and FIRMLY FORWARD — both actions at SAME time! SYNCRO blade teeth cut ONLY on DOWN stroke. (Fig. 2) Teeth raise, repel, push away any object on UP stroke. (Fig. 3) When blade moves UP it KICKS finger away free. On down stroke, blade does not move far enough to accidentally cut finger unless finger is intentionally, deliberately fed into blade like wood is fed in Figure 1. No wonder SYNCRO is the world's SAFEST saw . . . a feature old and young users acclaim!



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WORLD'S LARGEST MAKE

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SAFE
ETIC JIG SAW
CHRISTMAS DELIVERY!

15 BIG FEATURES

(1) WORLD'S SAFEST SAW. (2) PORTABLE . . . plugs into 50 or 60 cycle A.C. only 110-120 volt wall outlet. (3) NO ROTATING MOTOR NEEDED. Syncro's self-contained magnetic power unit transmits A.C. magnetic impulses to armature diaphragm—power transferred to saw blade. COIL wire, impregnated, baked. Guaranteed not to burn out! DIAPHRAGM of spring steel, heat treated under special process, suspended on L-I-V-E rubber mounting cartridges. (4) 14,400 STROKES PER MINUTE! (5) NO RECIPROCATING OR ROTATING PARTS TO WEAR OUT! (6) NEVER NEEDS OILING. (7) TABLE TOP 10" x 10". Largest magnetic jig saw table top made! heavy, thick, durable alloy die casting ⅛" thick, ribbed base. Surface smooth for easy sliding. Specially finished in ⅛" cross sectional engraved lines to assist in accurate cutting. (8) BASE 7½" x 6¾" . . . a heavy, durable die casting. (9) ARM is of specially formed steel stamping ⅛" x 1". Return Spring of heavy duty steel. Guide Slide of plated steel and adjustable to vary-ing wood thicknesses. Adjustment Screw permits easy, quick changes to compensate for voltages of 110 to 120 A.C. (10) THROAT CLEARANCE 13½" (greatest clearance of any magnetic jig saw made) permitting work on square sheet of wood, metal, plastic, 27" on the diagonal. (11) 5' cord . . . extension Underwriters' approved electric cable with molded rubber plug. (12) BLADES are 5" pin end style, of finest steel, 18 teeth per inch. (13) NO-MAR, NON-SLIP RUBBER FEET. (14) DURABLE—will last a lifetime. (15) HIGHEST QUALITY — guaranteed by the trademark name "SYNCRO".

NO MOTOR NEEDED—JUST PLUG IN! PORTABLE! SAFE! CUTS CLEAN, SMOOTH! NO SANDING!

ANNOUNCING a remarkable, SAFE, PATENTED, MAGNETIC Jig Saw—the perfect, lasting, family Christmas Gift to give—or get—now ready for immediate shipment! SYNCRO needs NO belt, NO gears, NO oiling! NO motor to buy! The high-speed, short stroke action, and freedom from belts, makes SYNCRO so SAFE even small boys and girls may operate it. Get this husky, powerful, 18 pound saw . . . so easily portable . . . you can use it anywhere—even on the kitchen table . . . so smooth-cutting no sanding is necessary! Cuts intricate designs on ⅝" soft wood, ½" medium hard plywood and thinner hardwoods, plastics, thin metals. Leaves NO ragged undersides on plywood or heavy cardboard. The rapid action blade cuts to the center of a 27" circle. SYNCRO is a rugged power tool for exceptionally high quality work. Ideal for hobbyists, craftsmen, light production. Perfect for models, displays, puzzles, inlays, silhouettes, toys, marquetry, games, what-nots, etc. Get yours NOW on our 10 Days' Money-Back Trial offer—enjoy a LIFETIME of use! Order on Coupon now!

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LIBERAL 10-DAY TRIAL OFFER:
When you receive your SYNCRO, plug it into any 50 or 60 cycle (A.C. only) 110-120 volt wall outlet and saw, according to instructions. THEN . . . if it does not saw cleaner, better than any other jig saw you ever used and with more safety . . . if it does not satisfy YOU, return it undamaged, postpaid and postmarked within 10 days of its delivery date . . . and then your $17.50 will be refunded promptly without question.

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Export Address: 120 Wall St., N. Y. City

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